MINES

AND

MINERALS

OF THE

PROVINCE OF QUEBEC

BY

J. OBALSKI

GOVERNMENT MINING ENGINEER

1889-1890.

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INTRODUCTION.

The aim of the present work is to collect into a single volume and classify, for the public convenience, all the information of a practical nature in regard to the minerals of the province of Quebec, which has hitherto only existed in scattered form in the reports of the Geological Survey of Canada, as well as in those of the Crown Lands Department of Quebec and in reports of a private character. These are the sources upon which we have drawn, after carefully eliminating everything foreign to the object of this work, or of a purely scientific interest only, and adding all such data as personal observation has enabled us to gather during more than eight years of fieldwork and investigation The sources of our information are, moreover, noted, as occasion requires.

The different points in the province at which the various minerals occur, as well as those at which they are worked, have been designated with all possible exactness, and, for facility of reference, an alphabetical table, indicating all the localities mentioned, has been provided at the end of the volume.

Nearly all the mines referred to in the course of this work have been personally visited by us, and our information is not only derived from the most reliable sources, but comes down to quite recent date.

The statistics relating to the production of the mines of the province and to the volume of our mineral exports to other countries have been taken from the official tables of trade and navigation issued by the Department of Customs at Ottawa; but as these returns, in so far as each province of the Dominion is concerned, only show the figures of the exports from the different ports of shipment, and as, in most cases, these figures materially differ from the real production of those provinces, it has been deemed advisable to only resort to them in certain exceptional cases hereinafter specified. Moreover, most of the companies, previously consulted by us on the subject, vouch for the accuracy of the figures of their respective outputs as herein given.

The condition of the mines of the province is given for the period extending to the close of 1889, and, in some cases, to the beginning of the current year.

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GEOLOGICAL SKETCH

According to the latest conclusions of the Geological Survey of Canada, the following are the only formations represented in this province :

Actual formation, represented by the superficial drift.
Quaternary formation, represented by the superficial drift.
(1) .....
Lower Carboniferous series, represented by the Bonaventure formation.
Devonian system, represented by the Gaspé sandstones.
Silurian and Cambro-Silurian system, represented by the Medina, Trenton and Chazy groups.
Cambrian system, represented by the upper portion of the Quebec group and the Calciferous and Potsdam formations.
Pre-Cambrian system, represented by the crystalline schists of the Eastern Townships.
Archean system, represented by the Huronian and Laurentian formations.
Eruptive rocks, represented by the granites, syenites, trachytes, traps, &c.

The Laurentian formation occupies the northern portion of the Gulf and River Saint Lawrence and contains phosphate, magnetic and titanic iron, plumbago and mica. together with granites, labradorites, limestones, &c., which have hitherto been little worked, but which are well adapted to furnish materials for building and ornamental purposes. A multitude of very curious mineralogical specimens are also met with in the crystallized state in the rocks of this system.

In the Huronian formation properly so called and noted in the neighborhood of Lake Temiscamingue, a mine of argentiferous galena occurs.

The Pre-Cambrian and Cambrian formations constitute the rich mineral district of the Eastern Townships and are characterized by the presence of the ores of copper, magnetic and specular iron, antimony, nickel, silver, and auriferous quartz. At several points in this region, the clay schists are quarried for roofing-slates and the limestones yield excellent quick lime and building stone. The same formations also contain the serpentines, which supply asbestos, soapstone and chromic iron.

The Silurian and Cambro-Silurian formations occupy the valley of the Saint Lawrence between Quebec and Montreal, and constitute the north-western limit of the Eastern Townships' mineral district. They are more particularly represented by the Trenton group, in which natural gas is found and in which it is also hoped to strike petroleum. The Trenton limestones furnish good quick lime and the building stone largely used in the cities of Quebec and Montreal.

(1) The series between these two formations is not represented in the province.

In the Gaspé district, the formation known as the Gaspé series presents itself. It is composed of Upper Silurian limestones and Devonian sandstones and, at many points of this group, the presence of petroleum has been recognized.

The Lower Carboniferous formation (Bonaventure) is represented only by small strips, on the south eastern coast of the Gaspé district, which form the northern limit or rim of the coal basins of Nova Scotia and New-Brunswick, but in which no workable coal seams have yet been discovered.

All these sedimentary formations are overlaid by alluvial deposits, frequently of great thickness and especially so in the valley of the Saint Lawrence, and these deposits yield the clay used for ordinary brick-making. On the surface, deposits of peat and bog iron are also numerous and sulphurous and saline springs abound in the Saint Lawrence valley.

In the interior, deposits of marl, sands and gravels are found.

In Beauce and adjoining counties, there are auriferons alluvions admittedly of great richness.

The eruptive rocks in the districts to the southward of the Saint Lawrence form mountains of no great height. Gray and white granites cover extensive surfaces, especially in the counties of Compton and Stanstead, and have long been the source from which the cities of Sherbrooke, Quebec and Montreal have derived some of their finest building material.

The Yamaska, Johnston, Rougemont, Montarville, Montreal, Rigaud, Brome and Shefford mountains are composed of diorite, dolerite and trachyte rocks.

The granites and syenites accompany the Laurentian rocks in Argenteuil, Joliette, &c., and at several points on the north shore of the River and Gulf of Saint Lawrence.

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IRON ORES [1]

The ores of iron are very abundant and of good quality in the province of Quebec, but are not worked or only so to a small extent on account of the absence of mineral fuel and the low import-duties imposed on foreign irons. At the present time there are only two establishments in operation, smelting the bog ore with charcoal: the Radnor forges, with one blast furnace, on the river au Lard, 30 miles north of Three Rivers, and those of Drummondville, with two blast furnaces, on the left bank of the river St. Francis, in the township of Grantham (Drummond).

The Canadian import duties on pig iron are now $4 per net ton of 2,000 lbs., the Federal Government further offering a bonus of $1 per net ton on all pig iron made in Canada from Canadian ore, (2) which is equivalent to a protection of the domestic metal to the extent of $5 per net ton of 2,000 lbs. or of $5.60 per gross ton. The import duty on bituminous coal and on coke amounts to 60 cts. per ton, while anthracite is admitted free of duty. We think that the most profitable way that we could adopt, under the circumstances, to develop our iron mines would be to export the raw ore, and for this it seems to us that the United States, which consume millions of tons yearly, would offer us a most favorable market, always making allowance for the fact that the best ore delivered at the furnace is not worth more than $8 a ton, which would necessitate short distance or very economical carriage.

The existence of iron ore appears to have been known from the very earliest times of the French colony. In 1737 the king of France, Louis XIV, authorized the "*Compagnie des Forges,*" to work and smelt the ore in the seigniory of St. Maurice and the fief St. Etienne, near Three Rivers. This company at once began operations and established the St. Maurice forges.

After several times changing owners, as well under the French as the

(1) Report of the Geological Survey of Canada, 1866-69 (T. Sterry Hunt) 1873-74 (B. J. Harrington). The manufacture of iron in Canada (J. H. Bartlett.)

(2) This bonus will be increased to $2, between the 1st July, 1892, and 30 June, 1897.

English regime, these establishments became in 1861 the property of Mr. John McDougall, of Montreal, who carried them on down to 1883, when they were definitely abandoned in consequence of the local scarcity of the ore and of fuel. It is claimed for these forges, which are now the property of Mr. McDougall, that they are the oldest of half the North American continent.

In 1798, a blast furnace and forges were established in the seigniory of Batiscan, near the river of the same name, but were also abandoned after a few years.

In 1860, the Radnor forges, on the river au Lard, in the seigniory of Cap de la Madeleine, were started by Messrs Larue & Co., their establishment comprising a blast furnace, charcoal kilns, forges and rolling mills. The firm had also a foundry at Three Rivers to manufacture car wheels. The blast furnace and foundry, now in other hands, are still in operation and turning out railway car wheels, which are much esteemed, and, at the London International Exhibition of 1862, a pair of wheels, made at this foundry, were shown, which had run 150,000 miles. Towards the beginning of 1890, the furnaces and foundry became the property of the "Canadian Iron Furnace Co."

About the same time, Mr. J. McDougall established another blast furnace under the name of the l'Islet Forges, at a short distance from the river St Maurice, in the same seigniory.

In 1869, another blast furnace was started near the river aux Vaches, in the county of Yamaska, and remained in operation until 1880.

In 1880, two other blast furnaces were established by Messrs. J. McDougall & Co. on the river St. Francis, at Drummondville. in the township of Grantham and these are still working.

In all these blast furnaces the ore treated is the variety known as iron bog ore, which is very abundant in those regions, carries 40 to 50% of iron, and is worked very cheaply. Charcoal is the fuel used.

In 1867, a Montreal company, (Canada Iron Mining and Manufacturing Co.) built a blast furnace at Hull, near Ottawa, for the purpose of utilizing a very important deposit of magnetic iron, but it only ran for a few years.

In 1873, the "Canadian Titanic Iron Co." erected two blast furnaces at St. Urbain, county of Charlevoix, to work an extensive bed of titanic iron. Charcoal was the combustible used and the furnaces were connected with Baie St. Paul by a small railway, but they were shut down after a very short experience, it having been found that they did not yield sufficiently profitable economic results.

In 1867, the company called the " Moisic Iron Co." erected at Moisic (Saguenay) bloomary furnaces to treat the magnetic sand, which is very abundant along the north shore of the Gulf of St. Lawrence. In order to utilize the output of these furnaces, a forge and rolling mills were established at Montreal, while at Quebec, a factory for the manufacture of steel directly from the sand by the Labreche-Viger process was projected. The sand was purified by Dr. Larue's process. These establishments continued in operation until 1876, turning out superior products, but without profitable resultsfinancially, owing to the increase of the duties in the United States.

In 1872, bloomary furnaces were erected by the " Haycock Iron Co." near Ottawa, to work a bed of magnetic iron, but were only in blast for a few years. The mines and forges are presently the property of the "Ottawa Iron and Steel Manufacturing Co."

Lastly, in 1881, the "Canadian Iron and Steel Co.," of Montreal, attempted at Hochelaga, near Montreal, to manufacture iron directly from the ore with the aid of Dr. Geo. Duryee's process and by using petroleum as fuel. Various ores of the province were thus treated, but the experiment does not appear to have succeeded, as the works have been abandoned.

It will consequently be seen that, of all the attempts made for the establishment of iron metallurgy in the province, the Radnor and Drummondville forges are the only ones still extant. Apart from financial considerations, the failure of these different enterprises appears to have been due, as already stated, to the scarcity of fuel and the question of the customs tariff.

In 1885, the " Bristol Iron Co." began the working of a mine of magnetic iron, mixed with hematite, in the township of Bristol (Pontiac) for the purpose of shipping the ore to the United States. But as this ore carried a strong proportion of pyrite, roasting kilns had to be provided, which, however, do not appear to have given satisfactory results, as, towards the close of 1889, the company entered into contracts to ship the raw ore to the United States; and, until further developments, this certainly seems to be the best way to turn to profitable account the products of our iron mines, if markets can be found for them abroad.

In the province of Quebec, iron occurs in the *magnetic state* in the rocks or in the form of sands, as hematite (compact or specular) and in the shape of bog ore.

Under the same head, notice will also be taken of *titanic iron*, *chromic iron*, and *iron pyrite*.

ORES OF MAGNETITE AND HEMATITE.

We shall divide these ores into two groups: 1o. Those of the Laurentian formation which are found in the counties of Pontiac, Ottawa, Argenteuil, Terrebonne, St. Maurice and on the north shore of the Gulf of St. Lawrence, in the form of magnetic sand.

2o. Those of the Eastern Townships, which occur more particularly in the altered rocks of the Quebec group (Cambrian and Pre-Cambrian formation) and especially in the counties of Sherbrooke, Brome, Wolfe, Beauce, Megantic, etc.

ORES OF THE LAURENTIAN ROCKS.—BRISTOL IRON MINE.

This mine, situated on lots 21 and 22½ N of the 2nd range of Bristol (Pontiac) was opened in 1872; but its development was only seriously begun in 1885, when the present "Bristol Iron Co." started regular works. The ore is a mixture of magnetite and hematite, with a variable proportion of iron pyrite, carrying sometimes as much as 2½ per cent. of sulphur. As the company's policy is to export only the raw ore and not to smelt it on the spot, roasting kilns were erected in 1883 to reduce to 7/10 per cent. the proportion of sulphur, and in 1885 a branch railway of 4½ miles long was built to connect the mine with the "Pontiac and Pacific Junction R. R."

In 1888-89, another roaster, which reduces the sulphur to ¼ per cent, was added to the plant, and, towards the end of 1889, the company contracted for the delivery of 5,000 tons of raw ore to be exported to the United States, with the option to increase the figure to 20,000 tons.

The company employs 60 men and its works are well equipped with steam machinery for hoisting and pumping and compressed air drills.

The output amounts to 125 tons per day, but is capable of increase with a stronger working staff. The bed carries two main veins (north and south) running in a direction N. N. W. following the strike of the Laurentian gneiss, and showing variable but very rich thicknesses of from 150 to 250 feet. These veins are distant two to three hundred feet from each other and have been traced for a quarter of a mile. The mine has been chiefly worked on the south vein by means of several openings, one of which is 150 feet deep, with a drift of 150 feet and several cross drifts of 20, 50 and 100 feet—all these workings being wholly in the ore, and the total output to date being about 12,000 tons.

The manager of the mine has supplied the following analyses :

Iron - - -	62.15	61.987	62.5	62.525	62.87	63.24
Sulphur - -	0.97	2.406	0.521	1.1673	2.221	1.08
Phosphorus -	0.0075	0.006	0.004	"	0.014	1.08
Silica - - -	8.52	7.32	0.004	"	"	1.08

The two first mentioned analyses were made on the raw ore and the four last on the ore after roasting.

It is said that later roasting experiments have still further greatly reduced the proportion of sulphur.

Analysis of the Geological Survey of Canada :

Peroxide of iron	65.44
Protoxide of iron	14.50
Bisulphide of iron	2.74
Protoxide of manganese	0.11
Alumina	0.60
Lime	3.90
Magnesia	0.45
Silica	11.45
Carbonic acid	1.64
Phosphoric acid	traces
Titanic acid	none
Water	0.14
	100.97
Total metallic iron	58.37
Sulphur	1.46

This mine possesses considerable importance in view of the fact that it is actually the only one in operation in the province, and it is to be hoped that the company's enterprise will be attended with success for the sake of encouraging other industries of the same kind.

MAGNETIC ORE OF HULL.

A very important deposit of magnetic iron, mixed with red hematite and graphite, occurs on lots 11 and 12 of th VIIth range of Hull (Ottawa), and was worked in 1854 by Forsyth & Co., who shipped several hundred tons of the mineral to Pittsburg, (U.S.)

In 1867, the "Canada Iron Mining and Manufacturing Company," of Mont-

real, built a blast furnace at the mine and produced a certain quantity of superior quality pig iron. The ore was treated with charcoal, and peat coke was also tried. In 1868, the furnace was blown out, the financial results not being deemed satisfactory. The ore was then distinguished as red ore, colored by hematite, and black. For some time afterwards the mineral was worked for exportation. Mr. Harrington reports that in 1873 the output amounted to 15,000 tons, but since then nothing has been done.

Analysis of the Geological Survey of Canada:

	Black ore.		Red ore.
Peroxide of iron	73.90	93.82	66.20
Protoxide of iron	....	....	17.78
Oxide of manganese	....	0.12	traces
Alumina	0.61	0.79	traces
Lime	0.	0.45	1.85
Magnesia	1.88	0.94	0.18
Phosphorus	0.027	0.08	0.015
Sulphur	0.085	0.11	0.28
Carbonic acid	"	"	1.17
Silica	20.27	3.75	11.11
Titanic acid	0.	"	0.
Graphite	"	"	"
Water	3.27	"	"
	100.042	100.06	99.295
Metallic iron	53.51	67.94	60.17

The mine is situated at a distance of eight miles from Ottawa.

LEDUC IRON MINE.

Situated on lot 23 of the VIth range of Wakefield (Ottawa). Magnetic iron in the Laurentian rocks.

Analysis of the Geological Survey of Canada:

Peroxide of iron	64.593
Protoxide of iron	30.819
Titanic acid	traces.
Phosphoric acid	0.027
Sulphur	0.
Insoluble	1.551
	96.990
Metallic iron	69.185
Phosphorus	0.012

GRENVILLE IRON MINE.

Situated on lot V½ S 3 of Grenville (Argenteuil) where a vein of 20 to 25 feet occurs in the Laurentian gneiss, running about N. W. and appearing to hold an average of 53.23 of metallic iron. In 1873, some workings were begun and several hundred tons of the ore were extracted. Similar ores, but in less thickness, outcrop on lots 4 of the VIIth, and 5 of the VIIIth range, as well as on lot 26 of the VIth range, of the township of Wentworth. Another vein, with a thickness of 20 feet, has been noted in the township of Grandison, in the same county.

ST. JEROME MINE.

In the seigniory of Mille Isles (Terrebonne) and at a short distance from the town of St. Jerome, there is a vein of magnetic iron, running N. W., following the stratification of the Laurentian gneiss, from which several hundred tons of good ore have been extracted—the working also exposing the vein for a distance of 1500 feet, with a thickness of 14 feet.

Under analysis, the ore gave the following results:

Iron	60.37
Titanic acid	0.55
Sulphur	0.452
Phosphorus	0.028

Another analysis made by the School of Mines at Paris:

Insoluble rocks	21.00
Titanic acid	traces
Peroxide of iron	77.30
Lime	traces
Magnesia	3.30
Phosphoric acid	0.
	101.60
Iron	53.59

The iron was all considered in the state of peroxide.

Analysis of the Geological Survey of Canada:

Hygroscopic water	0.0058
Peroxide of iron	59.059

Protoxide of iron	26.807
Titanic acid	0.
Phosphoric acid	0.015
Sulphur	0.001
Insoluble	9.897
	95.779
Metallic iron	62.191
Phosphorus	0.007
Sulphur	0.001

ST. BONIFACE IRON MINE.

This mine is situated on lots 23 and 24 of the 7th range of Shawenegan (St. Maurice) and carries an important vein of magnetite in the Laurentian rocks. A blast furnace was erected in the neighborhood, but, the bog ore being preferred, only very little of the mineral was taken out. The mine bears the name of the *Grondin Mine.* The blast furnace has been long shut down.

MAGNETIC IRON AT LAKE ABATAGOMAW.

In the report of the Geological Survey of Canada for 1870-71, the late Mr. J. Richardson notes an outcropping of magnetic iron with a breadth of 50 feet and a visible length of 200 steps, on the north-west side of lake Abatagamaw, beyond the Height of Land, in the lake Mistassini region. He also indicates in the same neighborhood a small deposit of ochre on the north-west flank of Paint Mountain.

OLIGIST IRON AND HEMATITE OF HULL.

This mine is located on lots 1 of the Xth range and 1 of the XIth range of Hull, and on lot 29, VI. of Templeton (Ottawa), and it is said that, in 1872. 5,000 tons of ore were extracted. Machinery was set up and a Catalan furnace was built for the manufacture of the iron, and an admittedly excellent article, was produced, but still the enterprise did not succeed. The property actually belongs to the "Ottawa Iron and Steel Manufacturing Co." The ore is a massive oligist iron occurring in the form of several beds in the Laurentian rocks, with a north-easterly trend and a width of from several inches to several feet and carrying a little magnetite. It is the only place where workable oligist iron has been found. The mine, which is known as the *Haycock Mine* and regarded as very important, is 10 miles from Ottawa and 6¼ miles from Gatineau Point for
ment.

Analysis of the Geological Survey of Canada:

Peroxide of iron	88.08	89.80	85.45
Frotoxide of iron	6.86	7.06	5.24
Protoxide of manganese	0.24	traces	0.15
Alumina	"	"	"
Lime	0.55	traces	0.15
Magnesia	0.13	0.22	0.17
Phosphoric acid	0.16	traces	0.13
Sulphur	0.03	traces	0.07
Carbonic acid	"	"	"
Silica	"	"	"
Titanic acid	3.17	2.34	2.12
Graphite	0.35	0.43	0.28
Water	"	"	"
Insoluble	0.26	0.11	5.77
	99.83	99.96	99.79
Metallic iron	66.98	68.34	63.88

In the case of the last analysis, the sample was an average one taken from a large pile of ore.

MAGNETIC SAND.

On the north shore of the Gulf of St. Lawrence, there are numerous and heavy deposits of magnetic iron in the form of sand. Indeed, it may be said to exist in all the sands of the coast, but it attains considerable development at certain points such as Moisic, Mingan, Betsiamits, Natashquan, Kagashka, &c. In January 1867, Mr. W. M. Molson, of Montreal, had tests made by treating the sand in a bloomary furnace, whereupon the "Moisic Iron Company" was organized to smelt the mineral at Moisic, furnaces being established at Moisic, and forges and rolling mills at Montreal.

The magnetic sand is met with almost on the surface in stratified beds from $\frac{1}{2}$ an inch to 6 inches thick, but sometimes attaining $1\frac{1}{2}$ to 2 feet. These deposits extend over large surfaces on the coast, in some instances for several leagues. Besides magnetic iron, this sand contains quartz, red garnet and titanic iron.

The following analyses are taken from the report of Dr. Sterry Hunt: (Geol. Survey, Canada, 1866-69.)

		Moisic.		Betsiamits.		Mingan.	
	1	2	3	4	5	6	7
Protoxide of iron	70.10	92.68	56.38	92.44	24.66	86.92	46.31
Peroxide of iron	"	"	"	"	22.24	"	"
Titanic acid	16.00	4.15	28.95	3.40	26.95	6.50	31.60
Oxide of manganese	"	0.40	1.10	undetermined	1.10	0.52	1.35
Lime	"	0.90	0.95	traces	1.12	0.75	1.06
Magnesia	"	"	"	"	0.72	0.70	0.50
Insoluble	5.92	1.95	8.75	3.85	23.80	4.20	15.50
	92.02	100.08	96.13	99.67	100.59	99.59	96.32
Metallic iron	55.23	66.73	43.85	66.56	34.94	65.58	36.00

Analysis No. 1 was that of the raw sand, 2, 4 and 6 of the magnetic portions, and 3, 5 and 7 of the non-magnetic.

It will be remarked that all the iron is indicated in the state of protoxide in the analysis of the raw ore or of the non-magnetic portion, on account of the difficulty of determining the degree of oxydation of the iron in the titanic mineral, which explains why the totals of the analyses are so much below 100.

The two next analyses were made in Belgium in the laboratories of metallurgical companies:

Protoxide of iron	28.04
Peroxide of iron	71.07
Sulphur and phosphorus	00.00
Equivalent to metallic iron	70.56

Oxide of magnetic iron	91.719
Insoluble silicates	1.082
Alumina	3.340
Lime	2.750
Magnesia	0.389
Sulphuric acid	0.099
Phosphoric acid	traces
	99.379
Metallic iron	71.337
Phosphorus	traces
Sulphur	0.039

Eight bloomary furnaces were built at Moisic, together with reverberating furnaces for re-heating.

The chief market for the Moisic blooms was then the United States, whither they were shipped for a time and entered as pig iron subject to a duty of $7, but, from the 2nd March, 1875, in consequence of representations and protests from the American iron-workers, it was assessed in the class of iron in bars and subjected to a duty of 1½ cent per lb., which completely closed to us the United States market and forced the company to shut down its works, go into liquidation, and sell out its property.

The Moisic iron was considered of excellent quality, equal to the best Swedish irons and well suited for the manufacture of the finest steel.

The sand was purified by Dr. H. LaRue's process, which consisted of magnets that isolated the magnetic part through a tympan. Dr. H. LaRue was also the inventor of a patent process to produce steel directly from the ore. (1)

At the same time an attempt was made by a Quebec company, "The Quebec Steel Works," to manufacture steel directly from the purified sands by the Labrèche-Viger process; but, owing to a variety of reasons, including the death of the inventor, the company did not succeed.

(1) Since then, several machines, based on the application of dynamic electricity, have been patented; among others, an apparatus invented by the celebrated electrician, Edison.

EASTERN TOWNSHIPS' ORES.

LEEDS IRON MINE.

On the northern part of lot 7 of the Vth range of Leeds, there is a very important outcropping of magnetic iron ore, stratified with the Pre-Cambrian chloritic slates. There appears to be a certain number of parallel veins, running N. N. E. and possessing a varying thickness. Other similar indications, as well as scattered blocks, have been met with for a distance of one to two miles and over a breadth of 700 feet, across the adjoining lots 1, 2 and 3 of the Xth range, which seem to point to the existence of a very extensive bed. The encasing rock also contains quartz and calc-spar. This mine has not been worked for the general reasons already indicated. It lies at a distance of 10 miles from Robertson station on the Q. C. R., of 20 miles from Ste. Julie (Grand Trunk) and of 5 miles from Leeds village. It would be easy to develop, as it occurs on hills about 50 feet above the surrounding lands.

Analysis of the Geological Survey of Canada:

Peroxide of iron	80.758
Protoxide of iron	13.588
Protoxide of manganese	0.056
Insoluble silica	0.012
Alumina	0.713
Lime	1.298
Magnesia	0.454
Phosphoric acid	0.471
Sulphuric acid	0.095
Titanic acid	0.
Hygroscopic water	0.049
Combination water	0.167
Organic matter	0.041
Insoluble	2.748
	100.450
Iron as peroxide	56.531
Iron as protoxide	10.568
Metallic iron, total	67.099
Phosphorus	0.206
Sulphur	0.038

The insoluble residue, being also analyzed, contained:

Silica	2.420
Alumina	0.270
Lime	0.014
Magnesia	0.012
Potash	0.076
	2.792

According to other assays, Mr. Hoffman estimates at 0.188 % the average percentage of phosphorus.

BROME AND SUTTON MINES.

In the chloritic slates forming part of the altered rocks of the Quebec group, (Cambrian) iron ores are found mixed with those slates to such an extent that they may be regarded as genuine ores of oligist (specular) iron. The richness of the veins varies according to the state of impregnation, but increases from the extremities towards the centre, which is occasionally composed of nearly pure ore carrying almost 78 % of peroxide of iron. The percentage of the workable portions seems to vary between 25 and 70 % of peroxide of iron, with an average of 45 %, which corresponds to 31 % of metallic iron. These ores are very quartzose and contain very little magnesia and lime. They also appear to be free from sulphur and phosphorus.

The following analyses, though incomplete, nevertheless give an idea of their composition: *(Geological Survey of Canada.)*

Peroxide of iron	38.07	47.4	45.4
Insoluble	55.70	44.6	5.25
Volatile	0.20	"	2.00
Alumina, magnesia	4.02	2.00	"
Metallic iron			31.8

The ore occurs over large sections in beds interstratified with slates and quartz veins. For instance, on lot 5 of the IXth range of Sutton, a section of 20 feet has been noted, together with one of 60 feet on lot 6, and one of 50 feet, in which there is a compact body of 15 feet, on lot 7. The working of the vein at this point yielded a hundred tons of good ore.

The same veins extend northward into the township of Brome, where outcroppings are met on lots 1, 2 and 6, of the IIIrd range, 5 and 6 of the IVth range, and 4 of the Vth, with thicknesses ranging from 1 to 18 and 20 feet. (III, 1.)

These beds are occasionally raised by the folds of the rock and then present different dips; the general direction being N. E. A little ore has been mined on lots 5 and 6 of the IVth range. The ores from lots 7 of the IXth range of Sutton, 1 of the IIIrd and 5 and 6 of the IVth range of Brome, have, it appears, been treated at Troy (U.S.) where, mixed with rich ores, they gave pretty good results. The central point of these workings is about 2½ miles from Sutton station (C. P. R.)

In the Geology of Canada, 1863, these ores are called specular schists and *itabirites*, and regarded as a mixture of grains of iron, quartz and chlorate, &c. Those found on lot 45 of St. Armand East (Missisquoi) are considered to be analogous ores.

In the neighborhood of the mines of Brome and Sutton, the magnetic ore found on lot 9 of the IXth range of Sutton should also be noted. It occurs in a 12 feet vein of dolomite, which also contains a vein of hematite 1 to 2 feet thick. This dolomitic vein gives the following analysis :

Carbonate of lime	40.10
" magnesia	20.20
" iron	10.65
" manganese	7.65
Insoluble	21.40
	100.00

The vein is calculated to contain 56% of magnetic ore, equivalent to 36% of metallic iron.

The fact should also be noted that the ores of this region are frequently titaniferous and contain from 1 to 2% of titanic acid. This titanic iron (1 and 2%) seems to be derived from the admixture of titaniferous minerals and to not form part of the ore itself. On lots 9, XI and 8, IX of Sutton and 1, III of Brome, an ore has been found which is genuine titanic iron, showing, according to Mr. B. J. Harrington, the following proportions :

	SUTTON		BROME
	XI. 9.	IX. 8.	III. 1.
Metallic iron	40.87	39.14	41.46
Titanic iron	27.20	29.86	24.16

SHERBROOKE IRON MINE.

This mine, which is known under the name of the "Belvedere Iron Mine," occurs on lot 8 of the IXth range of Ascot. The ore is a mixture of magnetite and hematite, impregnating the Pre-Cambrian sandstones. A cutting has been made which lays bare the vein and from which some hundreds of tons have been removed. The following analyses have been supplied by the owner of the mine :

Protoxide of iron	10.43
Sesquioxide of iron	59.09
Silica	19.50
Magnesia	3.58
Lime	1.58
Protoxide of manganese	0.55
Carbonic acid	5.17
Phosphoric acid	0.17
Titanic acid	0.00
Sulphur	0.06
Water	0.08
	100.21
Metallic iron	49.48

Sesquioxide of iron	34.75
Protoxide of iron	22.40
Protoxide of manganese	1.10
Alumina	0.75
Magnesia	1.25
Sulphur	1.50
Phosphoric acid	traces
Silica and insoluble residue	38.25
	100.00

The general grade of the ore does not appear to be very high, on account of its mixture with the country rock, but the quantity is abundant and the vein, with an exposure approaching 6 feet thick, follows the slope of the rock, dipping at an angle of 45° and in a north easterly direction. The mine is located on a hill 1,000 feet above the river St. Francis, 2 miles from Lennoxville station, (Boston and Maine Passumpsic R. R.), and 3 miles from Huntingdon station, (Grand Trunk.)

S. E. SMITH'S MINE.

Situated on lot 21 of the VIth range of Ascot., (Sherbrooke) about 2 miles from Sherbrooke. The ore consists of slates of the Pre-Cambrian impregnated with magnetic mineral for a thickness of 10 to 15 feet. Some work has been done and several hundred tons taken out. The ore, which is slightly calcareous, is considered of good quality. Specular iron is found on the surface.

Analysis of the Geological Survey :

Peroxide of iron	49.776
Protoxide of iron	24.725

Titanic acid	.0
Phosphoric acid	1.512
Sulphur	0.024
Insoluble matter	11.235
Metallic iron	55.074
Phosphorus	0.660
Sulphur	0.024

In the neighborhood of Sherbrooke itself, remarkable specimens of compact specular iron and hematite have also been found.

These ores are often seen in contact with outcropping veins carrying copper or magnetic iron, but the workings have failed to bring to light any important discovery.

MAGNETIC IRON OF LAKE NICOLET.

On the northern bank of Lake Nicolet, on lot 21 of the Ist range of South Ham (Wolfe) a very regular vein of iron occurs, with a thickness of 6 to 13 feet, on the surface, and traceable by the outcroppings for a distance of 200 feet in a north westerly direction.

This vein is found in the serpentine or rather at the contact of the serpentine with the Cambrian slates. A remarkable peculiarity of this ore is that it is imbedded in the fissures of a bed of green carbonate of copper. An assay made by Mr. H. Nagant, chemist, of Quebec, has also shown the presence of 4% of sesquioxide of chrome. From a 12 feet pit, 100 tons of good ore were extracted, the vein at the bottom showing a thickness of 9 feet. This deposit is 10 miles distant from the Garthby station of the Q. C. R. The mixture of the different ores makes it an interesting study and may give it some industrial importance.

MAGNETIC IRON MINE IN THE SEIGNIORY OF RIGAUD-VAUDREUIL (BEAUCE.)

Attention has also been called to a bed of magnetic and titanic iron in the serpentine near the river des Plantes, which is said to be 45 feet thick and to be composed of magnetic iron, properly so-called, and of ilmenite in very large proportions. This deposit, which occurs at a distance of 4 miles from the branch of the Quebec Central running to St. François de Beauce, has not been worked. It should be regarded rather as an ore of titanic iron, which moreover forms a third of the mass. We shall again refer to it under the head of titanic iron.

We subjoin a list of all the localities where iron is known to exist in the magnetic and oligist state, and, from the foregoing explanations, the lots containing the one or the other of those varieties can be easily ascertained;—

ARGENTEUIL.—Grenville—V, 3½ S.; VII, 4; VII, 5.
Wentworth—VI, 26.
BROME.—Bolton—XIV, 2.
Brome—III, **1**, 2, **6**; IV, **5**, **6**; V, **5½** E., 6½ E.
Sutton—VIII, 6; IX, 5, 6, 7, 9; X, 7, 8; XI, 9.
DRUMMOND.—Simpson—XII, 8.
MEGANTIC.—Inverness—II, 4.
Ireland—IV, 12.
Leeds—V, 7; X, 2, 3; XIII, 17; XVI, 10½ S. W.
MISSISQUOI.—St. Armand East—45.
St. Armand West—15.
Stanbridge—VI, 13; VII, 27.
OTTAWA.—Buckingham—VIII, 19¾ S.; IX, 17½ N.; XI, 17; XII, 26½ N.
Hull—VII, 11, 12; XI, 1; XIII, 14½ N.
Templeton—VI, 28½ N.
Wakefield—I, 7½ N.; III, 18, **19**; IV, **13**, 22, 23; V, **13½** S., **22½** E., 22½ W., **23**, 24½ S., **24½** N.; VI, **23½** S.
PONTIAC.—Bristol—I, 2, (II, 21, 22, Bristol Mining Co,)
Litchfield—I, 1, 12; VIII, 13.
RICHMOND.—Melbourne—I, 8.
SAGUENAY.—Betsiamits—I, 1, 2, 3, 4, 5, 6.
Laval—I, 2, 3, 4, 5; II, **8, 9, 10, 11, 12, 13, 14, 15**; III, **23, 24, 25, 26, 27, 28.**
Laflèche—I, A.
Letellier—I, D, E; 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20.
Musquarro—I, 1, 2, 3, 4, 5, 6.
SHERBROOKE.—Ascot—VI, 21; IX, 8, 16.
Orford—XV, 21, 22.
ST. MAURICE.—Shawenegan—VII, 23, 24.
STANSTEAD.—Stanstead—XIII, 24.
TERREBONNE.—Seigniory of Mille Isles (St. Jerome); Beresford—V, A, B, C.
WOLFE.—Ham South—I, 21.

Indications of magnetic iron have also been noted at several other points in Pontiac and Joliette, as well as on the Mattawin and St. Maurice rivers and at some places on the north shore of the Gulf of St. Lawrence.

BOG ORE.

These ores are hydrous peroxides of iron, containing a large proportion of organic matter. They occur in small patches or beds at or near the surface, in the alluvions, frequently associated with deposits of peat. and their formation is explained in the following way: infiltrating water charged with organic acids,

and passing over ferruginous deposits, dissolve and remove the iron in the form of salts of protoxide, and the latter, on reaching the surface, become peroxydized and insoluble in forming the deposits actually under consideration. These ores have a honey-combed appearance, which makes them easy to smelt; the organic matter which they contain also facilitating their reduction. They are particularly adapted to the manufacture of castings, and Canada was long supplied from the St. Maurice forges, with the iron from which its stoves, axes, &c., were made.

The numerous deposits of bog ore, especially in the St. Lawrence valley, induced the establishment of blast furnaces, which, generally speaking, gave satisfactory results by using, as fuel, charcoal obtained from the adjoining forests, and as motive power, the falls of the rivers.

The working of these deposits is primitive; the ore is simply removed with pick and shovel, and then washed, and in this way it can be delivered at the furnace for $1 to $2. The average theoretic yield is 50 % of metallic iron, but at the furnace the practical yield is from 30 to 40 %.

Reference has already been made to the blast furnaces established in the province. As for the different deposits of this ore, it will be enough to simply specify them, their description being uninteresting. Varying in thickness from a few inches to several feet and sometimes attaining as much as 7 or 8 feet, they cover surfaces of several acres and occasionally of several square miles. They are also found in certain lakes, such as Turtle lake *(de la Tortue)* on the line of the Piles railway. We propose to take a rapid glance at the blast furnaces in the province :—

J. M. McDOUGALL & CO.

The blast furnaces of Drummondville are operated by this firm. They are situated in the township of Grantham (Drummond) on the left bank of the river St. Francis, a rapid in which is utilized to run a turbine driving the blower. The establishment comprises two furnaces, heated by charcoal, with hot air blast, the heating by air being derived from the waste gases of the blast furnace. The blower is worked by a turbine and, at need, a steam engine is also used. There are upwards of 14 charcoal kilns capable each of charring 60 cords of wood in five days.

The two blast furnaces are respectively 32 and 35 feet high and are furnished with five twyers, the blast produced having a pressure of an inch to an inch and a half of mercury. These two blast furnaces are constructed, in the usual massive form, of masonry. Their dimensions are as follows :

Diameter at throat,	48 inches,		36 inches.	
" boshes	120	"	108	"
" hearth	40	"	40	"

Each furnace consumes, every 12 hours, 36 charges made up as follows:

24 bushels of charcoal.
1 barrel or 600 lbs. of bog ore,
1½ bushel of lime.

The two tappings in the 24 hours yield per furnace an average of five tons, which is manufactured by the same company into car wheels at Montreal.

The company consumes about 10,000 tons of ore annually and, with its two furnaces, can turn out from 3,000 to 4,000 tons of pig iron. The ore comes from the townships of Simpson, Bulstrode, Grantham, Wickham, (Drummond), Acton (Bagot) St. Wenceslas (Nicolet) and St. Lazare (Vaudreuil.)

The limestone used as flux comes from the vicinity of Drummondville, and about 1,500 tons of it a year are consumed. Attempts have been made to mix the magnetic with the bog ore in the furnace, but the results obtained were not satisfactory.

The company gives permanent employment to 75 men, on the average, exclusive of those engaged in hauling and in wood-cutting, who increase the figure to 300 in winter.

These two blast furnaces have produced 30,000 tons pig iron since their establishment in 1880 and 1881. At the time of our visit in 1889, only one had been working uninterruptedly during the previous seven months. A branch railway of half a mile long connects them with the Drummondville station (C. P. R.)

RADNOR FORGES.

This establishment, which comprises at present only one blast furnace, was started in 1860 by Messrs LaRue & Co., who also erected the forges and rolling mills now destroyed. The forges are situated in the Ste. Marguerite range of the seigniory of Cap de la Madeleine (Champlain) at the place called Fermont, on the river au Lard. All that remains of them now is the blast furnace, 21 feet high, working with charcoal and the hot blast. The water power of the river au Lard is used to drive a turbine, which works the blower, steam being employed in its place at need. There are 8 charcoal kilns. The pig iron produced is utilized at Three Rivers in the car wheel foundry of Messrs McDougall. The ore comes from the neighborhood of Fermont and from Turtle Lake (*à la Tortue*) which last is the company's property and from which the ore is removed by steam dredges. In 1880, an estimate was made, showing that 4,000 tons a year could be extracted from it during 20 years. The cost price of the ore extracted from the lake is moreover much below the rate paid to the farmers for surface ore.

The lime is procured in the neighborhood. The blast furnace, which was several times blown out, was leased in 1889 to Mr. McDougall, of Three Rivers, who worked it during a part of the year, and can turn out from 3 to 4 tons a day or 1,200 to 1,500 tons a year.

The establishment is $2\frac{1}{2}$ miles distant from the branch railway between Three Rivers and the Piles (C. P. R.), St. Maurice station, which is 25 miles from Three Rivers.

The Radnor forges, together with the ore lands, lake *à la Tortue* and the foundry at Three Rivers, have just been purchased by the "Canada Iron Furnace Co," of Montreal, which proposes to also erect a blast furnace at Three Rivers.

OTHER WORKINGS.

As already stated, blast furnaces to reduce the same kind of ore were also erected on the Batiscan river, at l'Islet, and on the Yamaska river, but have been abandoned.

As regards the deposits, we confine ourselves to giving a certain number of analyses taken from the reports of the Geological Survey of Canada :

	Vaudreuil		Eardley	St. Maurice forges.		
Peroxide of iron	74.50	76.95	57.15	77.60	74.30	64.80
Sesquioxide of manganese	"	"	"	0.30	traces	5.50
Alumina	0.30	0.80	1.60	"	"	"
Silica	7.10	1.50	21.10	5.40	3.60	4.80
Phosphoric acid	7.10	1.50	21.10	1.81	1.80	not determined.
Volatile matter,	18.95	19.80	18.85	17.25	22.20	23.65
	100.85	95.05	99.20	102.26	101.90	98.75
Metallic iron	52.15	53.86	40.00	54.32	52.01	45.36

	Va idreuil.	L'Islet.
Peroxide of iron	40.96	69.64
Protoxide of iron	"	7.25
Oxide of manganese	26.34	0.05
Alumina	"	0.90
Lime	1.48	0.53
Magnesia	traces	traces
Phosphoric acid	0.60	"
Sulphuric acid	traces	0.05
Insoluble matter and soluble silica	12.08	1.93
Water and organic matter	17.97	22.04
	99.43	102.39
Metallic iron	28.67	54.36

LIST OF LOTS ON WHICH BOG ORE IS FOUND:

L'Assomption.....Seigniory of Lachenaye.
Bellechasse.....Seigniory of St. Valier.
Champlain .....Seigniories of Champlain, of Cap de la Madeleine, of Batiscan, and of St. Anne de la Pérade, Radnor (Lake à la Tortue) II.
Chicoutimi.....Bagot II.
Drummond.....Simpson XII, 8.
Gaspé .....York II, 22, 26.
Joliette.....Augmentation of Lanoraie and Dautray, Kildare I, 7, 8 II, 7, 8; IV, 7; V, 7.
Lévis.....Seigniory of Lauzon (St. Lambert.)
Lotbinière.....Seigniory of Lotbinière (mouth of the big river du Chêne.)
Megantic.....Ireland, IV, 12.
Missisquoi .....Stanbridge, VI, 13; VII, 27.
Ottawa.....Eardley, VIII, 21.
Portneuf.....Cap Santé.
St. Maurice.....Seigniory of Pointe du Lac, St. Etienne II, Augmentation of Caxton, Fief St. Etienne IV.
Sherbrooke.....Ascot IX, 16.
Stanstead .....Stanstead XIII, 24.
Temiscouata .....Seigniory of Cacouna, seigniory of Ile Verte, townships of Viger and Wentworth.
Two Mountains ...St. Eustache.
Vaudreuil.....Seigniory of Rigaud III, 12, 13, 14; seigniory of Vaudreuil, Cote St. Charles, 16, 17.
Wolfe.....South Ham, I, 28.

TITANIC IRON.

The ores of titanic iron are principally met with in the anorthosite rocks of the Upper Laurentian series, and, as demonstrated further on, extensive beds of them exist in the province of Quebec, but unfortunately they have so far acquired no economic value, on account of the extremely limited use of titanium in the manufacture of paints and dyes and the ore itself being too lean in iron and too refractory to be advantageously employed as iron ore. If industrial uses could be found for the titanium, we could supply the world with immense quantities.

ST. URBAIN MINES.

This bed is remarkable from the fact that its working as an iron ore has been attempted. It occurs on lot 17 of the seigniory of the Côte de Beaupré (Charlevoix county), near the village of St. Urbain, which is eight miles from

Baie St. Paul. It is situated on a hill 100 feet high, in which the ore bed has a thickness of 90 feet, and is exposed for a length of 300 feet, followed by other outcroppings for a distance of a mile. The ore is ilmenite (titaniferous iron) and is occasionally found containing reddish grains of rutile or of brookite (titanic acid). The mineral, which is non-magnetic, shows the following composition according to the reports of the Geological Survey of Canada:

Peroxide of iron	10.82	20.35
Protoxide of iron	37.06	29.57
Alumina	37.06	4.00
Lime	"	1.00
Magnesia	3.60	3.17
Titanic acid	48.60	40.00
Silica	"	1.91
	99.68	100.00
Metallic iron	36.12	37.25

Analysis made at the School of Mines, Paris:

Peroxide of iron	47.60
Titanic acid	10.60
Silica	23.60
Alumina	12.30
Lime	3.30
Magnesia	3.00
	100.40
Metallic iron	33.05

This analysis was made on a small sample probably containing a large proportion of rock.

An analysis of the St. Urbain pig iron, made at the same School, gave 0.03 % of titanium. By other analyses, 0.05, 0.26 and 0 % were found. In 1871 an English company, the "Canadian Titanic Iron Co.," erected at St. Urbain two blast furnaces equipped with hot air blasts and a complete plant and laid down a tramway to the river St. Lawrence.

The company also secured a certain quantity of wood-lands to manufacture the charcoal for the furnaces, and limestone quarries were further opened in the neighborhood. The furnaces went into blast in November, 1872, and worked until May, 1873, producing about 500 tons of excellent white pig iron. But, owing to the refractory nature of the ore, 200 to 300 and even 400 bushels of charcoal were required to make a ton of pig iron, and, under the circumstances, the com-

pany closed its works, went into liquidation and sold off the material at low price. In 1880, the last of the plant was removed. This attempt definitely settles therefore the question of the titanic ores, which, however, have been sometimes employed mixed with other ores for the hearths of puddling and re-heating furnaces. The causes of their failure in other respects are traceable especially to the lean percentage of iron and the refractory nature of the ore, but the quality of the product obtained was good.

OTHER BEDS.

Deposits of titanic iron occur under the same geological conditions at several other points, which it is sufficient to merely mention, namely, at St. Jerome (Terrebonne), at the river Duclos in the township of Bourget (Saguenay), and at the Bay of Seven Islands on the north shore of the Gulf of St. Lawrence, the ore at the latter place being also magnetic and showing the following composition:

Protoxide of iron	49.77
Titanic acid	34.30
Insoluble	6.35
	90.42
Metallic iron	38.70

The difference to 100 arises from the iron being indicated as protoxide. It is also found at Chateau-Richer (near Quebec) and at Rawdon (Montcalm).

All these ores are analogous in their composition to that of St. Urbain, containing 30 to 40 % of titanic acid and the same proportion of metallic iron.

It should also be mentioned that the magnetic sands of the North shore also contain a large proportion of grains of titanic iron.

TITANIC IRON IN THE EASTERN TOWNSHIPS.

In the north-eastern corner of the seigniory of Rigaud-Vaudreuil (Beauce), at a short distance from the river des Plantes, a bed occurs in the serpentine, with a thickness, it is said, of 45 feet, and composed of magnetic and titanic iron, which can be separated mechanically. It exists in the proportion of $\frac{2}{3}$ of magnetic iron to $\frac{1}{3}$ of titanic iron, and presents the following composition, according to the reports of the Geological Survey of Canada:—

Peroxide of iron	40.70
Titanic acid	48.60
Magnesia	2.44
Soluble	4.20
Water and loss	4.06
	100.00

In the iron ore beds of Brome and Sutton, there is a proportion of titanic acid to the extent of 1 to 2, susceptible of increase occasionally so as to convert the ore in question into genuine titanic iron.

LIST OF PLACES WHERE TITANIC IRON IS FOUND.

BEAUCE	Seigniory of Rigaud-Vaudreuil.
BROME	Brome III, 1.
	Sutton, IX, 8, XI, 9.
CHARLEVOIX	Seigniory of the Cote de Beaupré, 17 (St. Urbain).
CHICOUTIMI	Bourget, I, 34, 35.
MONTCALM	Rawdon (St. Julienne).
SAGUENAY	North Shore (Seven Islands' Bay).
TERREBONNE	Gore of the seigniory of Mille Isles.

CHROMIC IRON.

Until latterly, the salts of chrome or chromium were only employed in the arts as pigments or for dyeing in the compound form of red bichromate of potash, of the red and yellow chromates of lead and of the green oxyd of chromium, of which there are several important manufactures in England and the United States. Within a few years, however, they have been used in metallurgy for the making of chromic steel, which is remarkable for its hardness and intended for special uses. The demand for chrome ores has consequently increased; but, while the paint industry warranted the payment of as high as $40 to $60 a ton for them, their use in metallurgy would not be profitable at more than $15 to $20 a ton, which is their present average price. The specimens of Canadian chromic iron were much remarked at the Antwerp Exhibition and the London Colonial Exhibition, and led to demands for the ore. Unfortunately, as will be hereafter shown, if the deposits of this mineral are numerous, they are of little importance. Chromic iron occurs at many points throughout the Eastern Townships in the serpentines associated with the Cambrian formations. It is frequently found disseminated in those rocks and occasionally bunched or concentrated in the shape of pockets of several tons to a hundred tons. The small capacity of the deposits has hitherto prevented their profitable working; still small quantities have been extracted and shipped. Some work in this way has been done at the following places:—

South Ham, II, 20.—A dozen tons of the ore have been extracted, carrying 40 to 60% of the green sesquioxide. In the same township, on lot 27 of the Ist range, its presence, with a thickness of 3 to 4 feet, has been noted.

Wolfestown (Wolfe) III, 24.—At this point, there is a deposit, 3 to 5 feet thick and traceable for 600 feet, from which some 30 tons have been taken.

Thetford IV, 6—Dr. J. Reed has worked on a deposit, 1 to 2 feet thick and running for 100 feet, extracting 30 tons.

The same proprietor has shipped 36 tons from another bed in Leeds XI.

In the environs of Lake Memphremagog, an isolated block has been found, weighing several hundred tons and holding 65% of chromic acid.

On Mount Albert, in Gaspé, many specimens of this iron are also found, some of them weighing 20 lbs, but their source has not yet been traced.

We append the analyses of the Geological Survey of Canada:

	Bolton.	Lake Memphremagog.
Oxyde of chrome	45.90	49.75
Protoxide of iron	35.68	21.28
Alumina	3.20	11.30
Magnesia	15.03	18.13
	99.81	100.46

According to information in our possession, chromic iron would sell in Europe at 95 francs the gross ton c. i. f. at Liverpool for 42% of sesquioxide in large pieces or for 50% in ordinary pieces, with an increase of 2 francs per unit.

Some has been sold in the United States at $15 and $18 per 2,000 lbs. on the cars. As may be seen, these prices are analogous.

It is to be hoped that important beds will be discovered which; at these prices, might become sources of considerable profit.

The important bed found on lot 21 of the 1st range of South Ham near Lake Nicolet, the property of Dr. J. Reed, has already been noted under the head of magnetic iron. It is well to recall that this bed occurs in the neighborhood of the serpentine and that it carries 4 per cent of sesquioxyde of chrome, which, we suppose, should enhance its value. In the event of this proportion increasing with the depth, the bed would then become workable to advantage.

LIST OF PLACES WHERE CHROMIC IRON HAS BEEN FOUND.

Brome	Bolton, VI, **27**, VII, 13, 23½ W.
Gaspé	Head of the river St. Anne, (Mount Albert).
Megantic	Coleraine IV, **25**.
	Leeds X, 1.
	Thetford IV, 16, 19.

RICHMOND ..... Melbourne VI, 22½, N. E.
WOLFE ..... Garthby, (Isle of Breeches Lake).
South Ham I, 27, 11, II, 20.
Wolfestown II, 24½, N. W.; III, 23, 24.

IRON PYRITES.

The chief sources of sulphur in the province are the cupriferous pyrites of the Eastern Townships; schists are also frequently found containing variable proportions of cubic pyrite, but not in sufficient quantity to render them workable.

In the Laurentian rocks, as elsewhere mentioned, pyrites, often magnetic, are also found mixed with the rocks. They have been noted especially in the seigniory of d'Aillebout, in the gore of Lanoraie (Joliette), where they would appear to exist in large masses, as well as in the seigniory of Terrebonne. Lastly, pretty large specimens have been brought from the North shore of the St. Lawrence. But so far we are not aware that any of these beds have been investigated.

OCHRES.

The formation and composition of ferruginous ochres being somewhat similar to those of bog iron, they are consequently often found together in the same beds. They occur abundantly in the superficial deposits of the valley of the St. Lawrence and its tributaries. In the natural state, they possess little value, but, by preparation, they acquire commercial importance, even though the preparation be the rudimentary one of diluting the natural ochre in a tub, in which the mud is kept in agitation by a wheel, which has the effect of precipitating the heavy matters such as sand, grains of limonite, &c., to the bottom, while the lighter substances such as grass, wood, &c., are retained by a strainer, and the water, holding in suspension only the finer particles, is run into tubs in which they deposit themselves. After a sufficient rest for this purpose, the clear water is drained off and the ochre dried, when it is ready for shipment. The light yellow to the deep brown ochres are obtained in this way. On the other hand, by subjecting them to a moderate calcination in open kilns, fine red tints are produced—the calcined product also becoming magnetic. In some cases, the raw ochre is calcined without previous washing and is then crushed. Prices cannot be gauged by the quotations of the paints of commerce, prepared or unprepared; but we estimate that unpulverized ochre, in the state above indicated, may be worth from $25 to $30 a ton, increasing to $40 for the crushed product. The consumption of ochres is relatively limited and thus far few of the deposits have in consequence been worked. They are met with in surface deposits, from a few inches to several feet and sometimes to 7 or 8 feet in thickness, frequently mixed with peat or marl or interstratified with beds of those materials. They occasionally cover large tracts as in the case of the deposit at St. Malo, near Three Rivers, which, it is said, extends over 600 acres, those at Pointe du Lac, over 400, and those at Manicouagan over 300, frequently to a depth in the latter instance of 5 to 6 feet. At the bottom the ochre is generally of a white or greenish color, due probably to the fact that the iron is in the state of protoxide, but assumes a yellow or brownish hue at the surface, where it often also appears black, owing in all likelihood to the presence of the oxyde of manganese. According to chemical analysis, natural ochre seems to be a compound, in which the iron exists partly in the state of organic salts, which become transformed by calcination. We subjoin an analysis of the natural ochre coming from Ste. Anne (Montmorency):

Peroxide of iron	59.10
Organic acid	15.01
Insoluble silica	1.15
Sand	3.60
Water (by difference)	21.14
	100.00

POINTE DU LAC.—(St. Maurice).

In 1851, this important deposit was worked for some time and ochres were prepared and shipped to the United States.

ST. MALO.—(Seigniory of Cap de la Madeleine).

This bed has been regularly worked for the last 4 or 5 years by the "William Johnson Co." of Montreal, which has established a factory on the spot, near Three Rivers. This company manufactures a special paint called the "Johnson Magnetic Iron Paint," which is prepared at Montreal by pulverizing and crushing the calcined ochre from St. Malo.

The establishment at St. Malo consists of four calcining kilns or ovens in which the ochre procured in the neighborhood is simply calcined without washing and then bagged and sent to Montreal to be finished. It is situated quite close to the line of the C. P. R., about midway between the stations at Champlain and Three Rivers, and employs 40 men, working only in the summer time. Its output for four months of 1889 has been estimated at 800 tons of calcined ochre.

The prices of these ochres per ton are as follows:

Calcined in the raw state	$30
Calcined and crushed	40

The company has supplied the following analysis:

Peroxide of iron	92.00
Alumina	3.23
Silica	0.61
Sulphuric acid	0.10
Combination water	2.54
Moisture	1.52
	100.00

Another analysis of a sample dried at 212° Fahrenheit gave 92.66 of peroxide of iron.

In view of the growing demand for its product, the company proposes to extend its operations during the current year so as to increase its output.

In the vicinity of this same establishment, ochres were also calcined some years ago by Mr. Normand, of Three Rivers, and it is in contemplation to reopen these works on a larger scale next year.

LITTLE ROMAINE (North Shore.)

In 1883, the manufacture of dry ochre on a small scale was started by Mr. Argall on the Little Romaine river in the township of Iberville (Saguenay). The ochre was prepared, as already described, by purification and deposit and a large number of varieties were obtained in this way; calcined ochre was also prepared. A waterfall in the river was utilized for the motive power and with the aid of 5 men, 4 tons a week were turned out. The establishment is still in operation and it is proposed to enlarge it next season. We append several analyses supplied by Mr. Argall. It should be remarked that the three first relate to calcined ochres and the others to the natural ochres dried at a temperature approaching 212° Fahrenheit :

	Light Red.	Brownish Red.	Red.	Light Yellow.	Yellow.
Moisture at 212° F.....	1.10	2.40	2.75	5.85	6.85
Combination water.....	0.85	4.65	2.45	16.45	21.75
Protoxide of iron.....	traces	0.77	0.26	0.26	0.77
Peroxide of iron	90.36	83.91	88.36	72.14	64.83
Silicious matter.....	4.80	5.45	3.35	3.05	3.70
Alumina (by difference)....	2.89	2.82	2.83	2.25	2.10
	100.00	100.00	100.00	100.00	100.00

It is probable that the "combination water" also includes the organic matters in the case of the two last analyses.

MANICOUAGAN (North Shore.)

Two or three years since, an American fishing company established itself on the peninsula of Manicouagan and acquired the ochre beds there for the purpose of working them; but we have no information as to its operations.

LIST OF PLACES WHERE OCHRE HAS BEEN FOUND.

CHAMPLAIN	Seigniory of Cap de la Madeleine—St. Malo range (William Johnson Co.)
	Seigniory of Ste. Anne (Lake à la Peinture)—St. Margaret range.
CHICOUTIMI	Simard IV, 24, 25, 26 ; V, 26, 27, 28.
DRUMMOND	Durham IV, 4.
MONTCALM	Chertsey.
MONTMORENCY	Ste. Anne—Mouth of the river Ste. Anne.
OTTAWA	Hull X, 15. Eardley.
PONTIAC	Mansfield.
SAGUENAY	Betsiamits—Jeremie Islands, Escoumains.
	Iberville III, 23, 24, 25.
	Manicouagan I, II, III, IV, V, VI.
	Islets A, B, C.
	Des Monts—Blocks C, D.
ST. MAURICE	Seigniory of Pointe du Lac—St. Nicholas range.
VAUDREUIL	Seigniory of Vaudreuil—Cote St. Charles, 17.

MANGANESE.

In the province of Quebec, manganese only occurs in a few superficial deposits in the form of earthy peroxide or wad, often associated with bog ore. It is also found in the form of a carbonate in the dolomites of the Eastern Townships, especially in Sutton (Brome). But, at all these points, it does not occur in sufficient purity or quantity to be workable as an ore of manganese; still, mixed with the ores of iron, it improves their quality. It is also susceptible of utilization in the manufacture of pigments.

At the Magdalen Islands, pyrolusite (peroxide of manganese), mixed with hematite, has been noted. (1)

LIST OF PLACES WHERE MANGANESE HAS BEEN RECOGNIZED.

BEAUCE	Seigniory Aubert-Gallion (Pozer river)—Seigniory of Ste. Marie.
	Seigniory of St. Joseph (St. Bruno concession).
	Tring.
BROME	Bolton.
	Sutton.
GASPÉ	Magdalen Islands (Amherst Island).
QUEBEC	Near the city of Quebec.
RICHMOND	Cleveland.
STANSTEAD	Stanstead IV, 24; X, 9.
SHEFFORD	North Stukely I, 8.
TEMISCOUATA	Seigniory of Cacouna.

(1) Report of the Geological Survey of Canada, 1879-80. The same report mentions the presenee of workable *gypsum* or *sulphate of lime* on Amherst, Alright and Grindstone Islands.

COPPER.

The most important and indeed the only region in the province in which copper mining is now carried on is that known as the Eastern Townships.

At Watsheshoo, on the north shore of the Gulf of St. Lawrence, deposits of copper have also been noted, which appear to be identical with those stated in the early records of the French colony to have been granted by Louis XV to Jacques Cartier's nephew.

In his report to the Geological Survey of 1870-71, Mr. J. Richardson also refers to a deposit of pyritous copper on the N. W. bank of Lake Abatagamow, beyond the Height of Land, in the region of Lake Mistassini.

Previously to and about 1860, a great deal of prospecting for the metal was done throughout the Eastern Townships and a number of strong working companies were formed. In 1864, the price of copper reached its maximum at 40, 50 and even 59 cents per lb., a figure which it has never since exceeded. There was in consequence a rapid development of mining, and concentrating and smelting machinery was also erected; but copper soon resumed its normal value and as the ore, though abundant, was of low grade and transport difficult, a large number of the mines were abandoned. From 1872, prices fell steadily below 30 cents, until 1887, when they touched bottom at 10 to 13 cents per lb., and when the formation, towards the end of that year, of a syndicate in France to control the market induced a rise to 17 and 18 cents. But, owing to excessive production, the price again declined, the syndicate went into bankruptey, and in May, 1887, the quotation of copper had gone down to 10 and 11 cents, &c. During this brief period of better prices, there was a hope that the copper industry was about to take a fresh start in the province and new mining locations were accordingly sought for and efforts made to organize new companies. The company known as the "Excelsior Copper Co." dates from this period; but the sudden fall in copper abruptly put an end to the negotiations. At present there are only four important companies working in the province. However, it is well to remark that the ores, though generally lean in copper, contain a small proportion of silver, and are well adapted to the making of sulphuric acid. It would therefore he feasible for companies to establish themselves in the Eastern Townships with a view to utilizing the sulphur, while the copper and silver would add to the value of the ores. The industry would then be less liable to suffer from the fluctuations of the market and would become permanently

established in the province. As will appear hereinafter, an important firm. "G. H. Nichols & Co," of New York, has, within the last two years, begun the manufacture of sulphuric acid at Capelton, and is also making chemical fertilizers, into which Ottawa phosphates also enter as an ingredient. This fact is of the utmost importance for the province as regards the utilization of its minerals.

The Geology of Canada, 1863, and the report of the Geological Survey of Canada for 1866 establish that, in the region of the Eastern Townships, there exists a certain number of folds or undulations in the strata in whose synclinal areas important beds of copper ores occur, three great lines of these with an apparently N. E. trend being noted.

The first to the north embraces the mines of Acton, the second those of Harvey Hill, and the third those of Capelton.

These formations belong to the middle series of the Quebec group (Pre-Cambrian and Cambrian) and are composed of chloritic, micaceous, argillaceous, quartzose and talcose schists, interstratified with magnesian limestones frequently associated with diorite and serpentine. The ore is found imbedded or cemented in these limestones or impregnating the schists; the gangue being the limestone and the quartz or sometimes the schist forming the casing rock.

The copper-bearing strata are often affected by faults or dislocations, which disturb their regular continuity, as well as traversed by quartzose veins sometimes highly mineralized, as, for instance, at the Harvey Hill mines.

The following are the different states in which copper occurs:

Native copper.		
Cuprite or red oxyde containing theoretically	88.78%	of copper
Melaconite or black oxyde	79.82	"
Malachite or green hydro-carbonate	57.39	"
Azurite or blue hydro-carbonate	55.18	"
Chalcocite, (copper-glance,) vitreous sulphuret of copper	79.70	"
Bornite or erubescite, variegated sulphuret of copper and iron (purple ore)	55.58	"
Chalcopyrite, yellow sulphuret of copper and iron	34.40	"
Tetrahedrite or Fahlerz, grey arsenical copper, containing in addition sulphur, copper, iron, arsenic, antimony, lead, zinc, and frequently silver	25 to 40	"

It may be added that, in the sulphurets, the proportion of iron may greatly vary, and thus reduce the percentage much below the theoretical indication.

It may be said that all the varieties of copper have been found in the province, but only the different sulphurets need be mentioned as workable and worthy of attention. Native copper has been found in small quantities, but only on the Etchemin river, near St. Anselme, in the seigniory of Lauzon, at the St. Francis mine, in the township of Cleveland, and in ranges VII and VIII of Halifax. The carbonates are occasionally met with in association with the sulphurets, but not in any marked quantities.

We shall distinguish two classes of copper-bearing beds in the Eastern Townships:

1st. Those of low grade in copper, but forming very extensive deposits following the stratification of the casing rocks and chiefly composed of chalcopyrite or the yellow sulphuret, carrying a heavy percentage of iron.

The most remarkable deposits of this class are those of Capelton, of Garthby, of Lake Memphremagog, &c. A great many others of equal importance are noted in the report of the Geological Survey of Canada for 1866; but their working has been since abandoned.

As these ores grade in and about 5 %, they consequently contain about 40% of sulphur and a small quantity of silver or less than an ounce per unit of copper.

They are chiefly sought for the manufacture of sulphuric acid. Some companies, however, have treated them by roasting in the open air or in kilns or ovens, afterwards obtaining the copper either by smelting for mattes or by the wet process. At the present time, this last process is not used by any company.

2o The high grade deposits, which occur in the form of regular lodes in a gangue of quartz and feldspar, exemplified by the Harvey-Hill mines, in which chalcocite (copper glance) and bornite (purple ore) are found. In the same region, high grade chalcopyrite is met with impregnating the micaceous and talcose schists. These high grade ores may be exported directly as ores of copper and it seems that they are much esteemed on the Swansea market:

Copper ores are sold according to grade, which is determined either by the dry method (Swansea method) or by deducting 2 units from the grade obtained by the electrolytic test, with a deduction of $34 to $38 per ton of copper for the

expense of treating rich ores. The price is generally governed by the current quotations of Chili bar. For instance, in the case of an ore grading 55%, the current rate of Chili bar being £60 and the deduction $38, the ton of copper would be worth $300.38 = $262.

Equivalent for the ore 262 × 0.55 = $144.10.

Low grade ores are sold at open prices or for what they can bring.

In the case of the poor copper pyrites of the Eastern Townships utilized for the sulphur and carrying silver, the selling price is established on the following bases, subject to the fluctuations of the market :

Sulphur	$0.10	per unit.
Copper	0.05	per lb. in the ore.
Silver	0.835	per ounce.

EUSTIS MINING COMPANY (Boston).

This company works the "Eustis mine" situated on lot 2 of the IXth range of Ascot (Sherbrooke). This mine, which was formerly known as the "Crown mine," has been successively developed by the "Orford Nickel and Copper Company," the "Orford Copper and Sulphur Company," and lastly, since 1887, by the present company. The first workings were undertaken in 1872. The ore worked is a pyrite carrying an average of 5% of metallic copper and a slight proportion of silver, the gangue being quartz, and is advantageously employed for the sulphur, in the manufacture of sulphuric acid. It forms a visible vein on the surface running with the stratification of the chloritic schists (Pre-Cambrian) in a general direction E. 30° N. with a southwardly dip at an average angle of 50°. The value of the vein is established by the outcroppings and the underground workings which follow it to a depth of 1600 feet. At the present time, the mine is worked below by means of three inclined shafts, which expose the vein for a length of 400 feet, with a thickness ranging from 15 to 40 feet. This thickness moreover varies at different points, attaining a maximum of 65 feet. The ore is generally massive and free from impurities. The grade is variable, but in the deepest shaft (No. 1) it has reached 25% of copper. The following test made on a shipment of 400 tons is accepted as representing the average grade of the ore :

Copper	4.76%
Silver	3 ounces
Sulphur	40%

The silver is scattered throughout the whole mass and increases with the grade of the copper.

The mine was originally opened on the top of the hill, at a height of 600 feet over the Massawippi river. Work was begun starting from this shaft (No. 5) and, at a level of 400 feet lower, an adit, 1000 feet long, was run in to strike the lode, the development of which has been continued by means of the three shafts already mentioned and by leaving standing between them ore masses of 60 to 70 feet. These masses are from 50 to 120 feet high and constitute an important reserve, which can be drawn upon and removed at will. Mining work is carried on by means of compressed air drills and supports are provided for the mine by leaving pillars and putting up a few timbers; a single pump keeps down the water. As for the total output of the mine since its first working, it is difficult to estimate it, but it is believed that it cannot be far from 400,000 tons, and for the last ten years the annual output has been from 25,000 to 30,000 tons.

A part of the ore extracted is treated by the company and the remainder is shipped to New York for the manufacture of sulphuric acid, for which it is admittedly well adapted. At the works near the mine, there are 50 roasting ovens with a capacity of 1000 tons per month and 2 smelting furnaces for the reduction of the ore into matte.

In addition, a portion of the crude ore is roasted in the open air in piles containing as much as 250 tons and the combustion of which is kept up for two months and upwards. According to an analysis communicated to us, the roasted ore contains:

Copper	5.3%
Silver	3 ounces 8/10

The mattes turned out and supplied to the trade contain from 30 to 40% of copper and from 23 to 28 ounces of silver.

The company employs 250 men, one half of whom are engaged in the underground workings.

In 1888, 27,348 tons of crude ore were shipped, making, with the 1500 tons burnt in pile, a total of 28,848 tons. During the first 11 months of 1889

	13,341 tons of crude ore were shipped.
	16,474 tons were smelted
And there were	1,000 tons of small ore in pile.
	30,815

Which, keeping the same proportion for December, would bring up the total

output for the year to 34,000 tons. During the 11 months in question, 1565½ tons of mattes were shipped.

G. H. NICHOLS & CO. (New York).

This company chiefly works the "Albert" mine on lot 3 in the VIIIth range of Ascot (Sherbrooke), but it also owns the "Hartford" mine, on lot 3 of the IXth range, formerly worked by the "Canadian Copper and Sulphur Company." The character of the ore is identical with that of the neighboring Eustis mine and the output is also substantially the same. We are unfortunately unable to supply any details in regard to this mine, as we have not yet had occasion to visit it. The company, which has its headquarters in New York, employs the ore for the manufacture of sulphuric acid. In 1887, it established works at Capelton for this purpose, and in 1889, it associated with them works for the manufacture of chemical fertilizers and the treatment of Ottawa phosphates, of which it used 500 tons during the course of the year. It is said that the greater part of these fertilizers are consumed in the province. To the latter, the great importance of this industry cannot be too strongly insisted upon, providing, as it does, for the treatment of our phosphates with the acid derived from our own ores. In addition, most of the acid made is taken by the petroleum districts of Ontario. The company employs about 300 hands in its mines and works, and its annual output ranges between 30,000 and 40,000 tons of ore, about one sixth of which is utilized on the spot and the remainder shipped to New York. A large amount of ore has been taken out of this mine since its opening thirty or more years ago, but we are not in possession of the figures.

The company has also lately acquired the old "Huntingdon" mines chiefly situated on lot 8 in the VIIIth range of Bolton (Brome) and intends to develop them shortly.

MEMPHREMAGOG MINING COMPANY.

In 1889, this company opened a mine on lot 28 of the IXth range of Potton (Brome). This mine is located on the western shore of Lake Memphremagog and on the N. W. flank of the Hog's Back mountain, at an altitude of 700 feet over the level of the lake. The ore is copper pyrite heavily charged with iron and is similar to that found in other parts of the Eastern Townships. The fact however, should be noted that it is mixed with magnetic iron pyrite or pyrrhotine in the same way as the ore at the Huntingdon mine not far distant.

The following analyses made at New York have been supplied by the owners of the mine, the samples analyzed coming from the surface workings:

Moisture	1.60	....	....	....
Sulphur	46.70	41.71	49.50	37.76
Iron	37.68	32.10	41.40	50.99
Copper	2.25	5.00	0.17	4.93
Antimony	6.70	9.60	4.27	0.33
Nickel	traces	....	....	....
Cobalt	traces	traces	....	....
Zinc	....	....	....	1;71
Lead	....	....	....	2.47
Arsenic	traces	0.22	1.13	0.05
Silica	5.07	11.37	3.53	1.76
	100.00	100.00	100.00	100.00

A specimen, considered an average type, and analyzed by H. Nagant, chemist, Quebec, gave the following results :

Moisture	0.15
Silica	5.00
Lime and alumina	5.70
Sulphur	36.50
Iron	43.70
Nickel	traces
Silver	do
Zinc	2.30
Arsenic	traces more or less considerable
Lead	0.30
Copper	4.70
Antimony	1.65
	100.00
Specific gravity	4.17

According to Mr. Nagant, this ore is easily roasted, and, after undergoing proper burning, does not retain more than 1% of sulphur.

The ore vein has been traced for a distance of 600 feet, with variable thicknesses ranging from 10 feet on the surface to 22 feet in the principal working. In the spring of 1889, these workings consisted of a few open cuttings of no great depth. The company worked during the remainder of the year with a few men only, and took out 900 tons of ore which, however, have not been shipped. The vein runs N. 30° E., dipping westward at an angle of 40°, and occurs between the Pre-Cambrian schists and the diorite forming the Hog's Back mountain. The

location of the mine is 1 mile from Lake Memphremagog (Knowlton Landing), 12 miles from the Canadian Pacific (Eastman Station) with which it is connected by a good road, and 3 miles from the Missisquoi and Black River Valley Railway (Bolton station). a line no longer in operation.

OTHER MINES IN OPERATION.

In 1889, Mr. F. J. Falding did some important prospecting in Ascot on lots 5 of the XIth range ("Howard Mine") and 23 of the IIIrd range (Moulton Hill Mine) and incidentally took out about 3000 tons of ore, the bulk of which was shipped to the United States. On the last of these properties, a shaft had been sunk on an incline for a distance of 150 feet, which exposes a vein or series of veins apparently of great thickness, and at the Howard Mine a shaft of 200 feet shows a vein of 9 to 10 feet, while the extensive underground workings exhibit a large quantity of ore still standing. The Moulton Hill mine has just been equipped with plant for an output of 100 to 150 tons of ore per day and a similar equipment for the Howard mine is proposed. The ore is analogous to that of Capelton and both mines lie in proximity to the railway.

In 1889, prospecting on lot 22 of the Ist range of Garthby (Wolfe) also led to the discovery of a very rich deposit, which, it is said, will be shortly worked. The ore, in this case, is the same low grade copper pyrite which occurs in the vicinity of the diorite and serpentine and the bed appears to extend over the adjoining lots.

EXCELSIOR COPPER CO. (Limited, London.)

This company, formed in London in 1888, is now working the old "Harvey Hill Mine" on lot 17 of the XVth range of Leeds. It also owns all the lots which were the property of the old "English and Canadian Mining Company," viz: 15½, 16, 17, 18, 19, 20½ in the XIIIth; 15, 17½, 19, 20, 21½ in the XIVth and 15, 16, 17, 18, 19, 20, 21½ in the XVth range.

Towards 1860, the Harvey Hill Mine was worked on an extensive scale by the old company, which even erected works for concentrating the ore and smelting it into mattes. Numerous shafts were sunk, including among others the following: Kent, 168 feet, Eagle, 250, McGee, 23, Poulin, 32, Douglas, 60, Harvey Hill, 70; Whitburn, 230 and Fremont, 60. The most important and productive working appears to have been the "Fanny Eliza" vein, which, starting from the Kent shaft, was followed for a distance of 1,000 feet to a depth of 564 feet below the level of the shaft.

An adit was further run in from the foot of the hill for a distance of 1,500 feet, recutting several veins which were worked by means of shaft No. 1, 82′, No. 2, 138′ and several other intermediate workings.

The ore occurs in two different forms: 1o in beds in which the schists are impregnated with the yellow sulphuret (chalcopyrite) and which range from 2 to 12 feet thick; 2o, in quartz veins, in which variegated copper (bornite) and vitreous copper or copper-glance (chalcocite) mixed with white feldspar, are met with, sometimes in solid masses, and sometimes disseminated through the rock. The thickness of these courses is variable, ranging from 1 to 4 feet and upwards. The most remarkable of them (the Fanny Eliza vein) was followed for a distance of over 1000 feet and contained—it is said—pockets of very rich ore.

All these workings were suspended during fifteen years, but the new company has re-opened some of them: in the Poulin and McGee shafts, which are sunk on the same vein, in the Kent shaft, and on the veins and beds in the cross cut. Lastly, the water is being pumped out from the Fanny Eliza vein, in the hope of resuming work upon it.

The company started operations in 1888 and has since prosecuted them with an average working staff of 100 men, inclusive of those employed in the re-equipment. During a portion of the winter, the works have been suspended. In four months and a half, 520 tons of 20% to 50% ore and 270 tons of 6% to 25% were taken out and shipped.

According to the tests of Messrs. Vivian & Son, of Swansea, the following grades were determined in October, 1888:

Lot of 12 bags of 200 lbs.	$31\frac{7}{8}$%	of copper.
45	49	" "
46	$12\frac{3}{4}$	" "
22	$13\frac{1}{2}$	" "
240	$14\frac{1}{2}$	" "
32	$51\frac{3}{4}$	" "
55	$31\frac{5}{8}$	" "
90	$40\frac{1}{4}$	" "

In addition. there remain over at the mine 400 tons of waste carrying about 5% of copper, which the company proposes to reduce, together with a large amount of old waste. The company resumed work in the course of the summer of 1889, and. in order to utilize this waste, a smelting furnace for mattes was erected, to be heated in part with charcoal made on the company's property. As the result of other searches, too, a vein carrying splendid ore has been found on lot 17 in the XVth range and promises good results.

On lot 17 of the XIIIth range, a quartz vein occurs, with specular iron and a little copper, just alongside a bed of quartzose schists impregnated with specular iron, and containing numerous specks of copper producing green flakes of the carbonate; some very rich parts are also met with containing variegated copper. An opening has been made in this bed, which was found to be several feet thick and the ore has been used as a flux. At the period of our visit, in September, 1889, fifty men were employed at the mine, working only on lot 17 of the XIIIth range and in the Kent shaft, and we had occasion to notice, in the pumped out portion of the "Fanny Eliza," some fine indications of variegated copper. Attempts were then also being made to smelt the ore.

The mine lies near the village of St. Pierre de Broughton and at 8½ miles from the station of East Broughton, Q. C. R.

The ore generally contains silver; gold has also been found in it, and molybdenite in the Kent shaft.

In the following list will be found indicated all the lots on which copper has to our knowledge been discovered, without stating to what class the ore belongs. The names of the principal mines and of the companies that have worked them are also given between parentheses. Except those hereinafter designated, all these mines have been abandoned and it is possible that the properties may have since changed hands by succession or otherwise. Nevertheless, many of them are still very rich and there is no room to doubt that some of them will be again worked to advantage. The greater part of them are referred to in the report of the Geological Survey for 1866, which also contains a great deal of interesting details in regard to the copper deposits of this region:

LIST OF LOTS ON WHICH COPPER IS FOUND.

ARTHABASKA.—Bulstrode—II, **10.**
Chester—I, 9, 10, 13; II, 9; IV, 9, 23; V, 4, **6**, 9, **13**; VI, **5**, 8 (Viger Mine), 9, **15**; VII, 7, 8, 24; VIII, **7⅓** N. W. S. E., 19; IX, **2½** S. W., **5, 19**; X, 11, (19 Chester Mining Co.); XI, 10, 11, Craig's Road Range S., 11, 14.
Horton—V, 5.
Tingwick—IV, **1**; VII, 23; IX, 14, 17, 23, 26, 27, 28, 29.
Warwick—I, 11; X, 9.
BAGOT.—Acton—III, 31, (32 Acton Mine); IV, 31; V, 32; VI, 28, 29, 30; VII, 29, 37, 38; VIII, 26, 27, 28.

BEAUCE.—Broughton—V, 10, 12; VI, 13.

BROME.—Brome—III, 1, 2, 6; IV, 2, 3, 6; V, 1, 5 (Canada Copper Mining Co.); VI, 1, 2, 6, 7; VII, 6, 12 (Tibbet's Hill Mine); VIII, 7, 13, 18, 19; IX, 13, 20, 21; X, 8, 23, 24, 27; XI, 16, 25.

Bolton—I, 1, 6, 10, 11; II, 4; IV, 1, 5, 18p.; V, 1p., 28; VII, 1, 14, 25, 26, 27; VIII, 4, 6, 8 (Huntingdon Mining Co.), 22; IX, 2, 3 (Ives Mining Co.); X, 27; XI, 3.

Potton—V, 17, 20, 21, 24, 27; VI, 20, 24; IX, (28¼ N. E. Memphremagog Mining Co.); X, 14.

Sutton—III, 2; IV, 5; V, 3; VI, 1, 5, 6; VII, 9; VIII, 3, 4, 7, 8, 10, 14, 16; IX, 2, 3, 9, 10, 11; X, 4, 7, (8½ W. Sutton Mining Co.), 10, (11, 12 North Sutton Mining Co.); XI, 3, 5, 7, (9½ E. Brome Mining Co.), 10, 11, (12 North Sutton Mining Co.).

DORCHESTER.—Frampton—II, 14.

DRUMMOND.—Durham—IV, 9; V, 9; VI, 6, 7, 8, 9½ N. E., 18, 23; VII, 5, 11, (21 Durham Mine); VIII, 7; X, 17.

Grantham—II, 4, 5.

Kingsey—I, 3, 4, 5; III, 2, 3, 4½ N. E.—4½ S. W.—IV, 3½ N. E., 4; VIII, 8.

Simpson—I, 1; II, 1.

Upton—XX, (49 Bissonnette Mine), (51 Prince of Wales Mine); XXI, (49 McDougall Mine), (50 Upton Mine), 51.

Wendover—I, 1; II, 2.

Wickham—IX, 3, 14, 17, 18, 19; X, (13 Wickham Mine), 14, 15, 19; XII, 13, 26.

LOTBINIÈRE.—Sgry. St. Gilles de Beaurivage.

Handkerchief—St. Marguerite range, St. Marie concession, 3.

MEGANTIC.—Halifax—I, 10; III, (10 Halifax Mining Co.), 16½ N. W., 18; V, 6, 18; VI, 6; VII, 5, (6 Megantic Mining Co.), 9, 21; VIII, (9 Black Lake Mine); IX, 4, 6, (9 Black Mine); XI, 6, 7, 12.

Inverness—I, 7; II, 4, 19; III, 22; IV, 2, 4.

Ireland—I, 3; IX, 9; XI, 4; VI, 9½ N. W., 14; XI, 23.

Leeds—II, 6; IV, 4; IX, 8; X, 8, 9, 10, 11; XI, 5, 6, 11, 12, 13, 20; XII, 10, 11, 13, 18; XIII, 16, 17, 23; XIV, 13½ S. W., 14, (15; XV, 16, 17 Harvey Hill Mine Excelsior Copper Co.), 18.

Nelson—II, 8.

Somerset—VIII, 14, 15.

Thetford—I, 6.

MISSISQUOI.—Dunham—I, 25, 26; II, 23; III, 14; VII, 10, 11; IX, 1, 2, 5.

St. Armand East—35, 36.

St. Armand West—51, 52, 53.

RICHMOND.—Brompton—IX, 11, (28, 29 Brompton Gore Mine); X, 11, 14.
Cleveland—VIII, 23; IX, 11, 27; X, 24, 25, 28; XI, 19, 23, 24, 25; XII, 21, 22, (25 St. Francis Mine); XII, 21, 22, 23, 24, 25, (26 Jackson Mine); XIV, 5, 21, 22, 23, 26.
Melbourne—I, 2, 4, 5, 8; II, (2 Ryan Hill Mine,) 3, (6 Cold Spring Mine); III, 2, 3, 6, 7; IV, (2 Balrath Mine), 3; V, 2; VI, 2, 3; VII, 1, 3, 5; VIII, 5.
Shipton—II, 13; III, 7; V, 16; VII, 21; VIII, 22; X, 11.
Windsor—VIII, 8; XII, 6.

SHERBROOKE.—Ascot—II, 25; III, 22, (23 Moulton Hill Mine); V, 17, 20, 24; VI, 7, 8, 10, 12, 13. 14, 16, 17, 20; VII, 5, (11 Clark Mine), (12 Sherbrooke Mine), 13, 14, 15, 16, 19, 21; VIII, 2, (3 G. A. Nichols & Co. Albert Mine), 4¼ S. E. Capel Mine, (4¼ N.E. Champion Mine), 6, 7, (8½ W. Ascot Mine), 8½ E., 9, 10, 11, 12, 13, (14 Short Mine); IX, (2 Eustis Mine), 3 Hartford Mine.—4 McCaw & Co., 6 Harrington Mine), 9, (10 Belocdere Mine) 11, 13; X, 5; XI, 1, (3 Griffith Mine), 4, (5 Howard Mine).
Orford—r. A. 4, 8, 9, B. 9, F. 3, 6, 8; XII, 2, 5; XIII, (3 King Mine), 4, 6; (XIV, 2, 3; XV, 2, 3 Carbuncle Hill Mine); XVIII, 9, 16.

SHEFFORD.—Ely—I, 3, 9, 11, 12; II, (9, 10 Ely Copper Mining Co.), **22**; III, 6, 8, 12; IV, 17; V, 7; XI, 23, 24.
Granby—VI, 18; X, 17.
Hatley—I, 27 (28 Bird Hill Mine); II, 27, (28 Massawippi Mining Co.); III, 26, 27, 28; IV, 25.
Milton—I, 11, 12, 13; II, 1, 2, 13; III, 1, 11; IV, 11; V, 19; VII, 2; VIII, 2.
Roxton—II, 4; III, (23½ W. Lord Aylmer), (23½ E. N. Lafontaine); VII, 21, 27; VIII, 3, 26, 27; IX, 27, 28.
Shefford—II, 27, (28 Glencoe Mining Co.); III, 24, 26, 27, (28 Waterloo Mining Co.)
Stukely—I, (6 Grand Trunk Mine), 7, 9, 10; II, 7; III, 4; IV, 2, 4; VI, 9, 10, 13; VII, 1, 2, 8, 27; VIII, 2, 7, 8, 28; IX, 2, 3, 4, 5, 6, 8; X, 1, 4, 5, 6, 7, 8; XI, 5, 11.

WOLFE.—Garthby—I, S. 22; II, 19.
North Ham—III, **27**; IV, 27, (28 Nicolet Branch Mine); A. **25**, **26**, 27, **28**; B. **28**, **33**, **34**, **35**, **36**, **46**.
South Ham—I, 22; II; **2**, 26, 27.
Wolfestown—VII, 1, 4; IX, 4, 5, 6; X, 14; XI, **15**, **16**.
Wotton—I, 10; II, 22; III, 7; V, 7; VI, **7**; VII, **6**, 7; VIII, **1**.

The presence of copper has also been noted in the seigniories of Gaspé (Lotbinière), Lauzon and Sillery, (Levis), St. Joseph (Beauce), as well as Watesheshoo (North shore of the Gulf of St. Lawrence), and at Lake Abatagomow in the region of Lake Mistassini.

LEAD.

Galena or sulphuret of lead is only sparsely distributed throughout the province of Quebec. In small quantities, it is often found associated with the copper ores of the Eastern Townships, as at Upton, Acton, Ascot, Potton, St. Armand and Chester. A mine has been recently opened on the shores of Lake Memphremagog in Potton, but we lack information in regard to it. In all probability, however, it is identical with the one mentioned as having been opened there thirty years ago.

Some small and unimportant veins of galena have also been found in the rocks of the Laurentian series, as at Buckingham and Baie St. Paul.

In the *Gaspé sandstones*, on the north shore of Gaspé Bay and especially at Little Gaspé, Grand Grève and Indian Cove, galena has been observed in numerous veins, associated with calcite. About thirty years ago, an attempt was made to work them at Little Gaspé by sinking three trial shafts to a depth of 20 feet and making a few cuttings, from which some 20 tons of the mineral were extracted, holding 60% of lead and traces of silver. The thickness of the ore-bearing portions of the veins did not exceed 8 to 10 inches. Since then, work upon them has heen suspended or has been confined to prospecting. In 1888, a St. Paul (Minnesota) company sank a shaft to a depth of 40 feet at Indian Cove, but did not further continue operations. The veins, which are small, but numerous, appear to accompany the dislocations, which have brought the limestone to the surface, and outcrop even on the sea shore. A more thorough search might lead to the discovery of workable deposits.

On lot 10½ W. of the IVth range of Calumet Island (Pontiac) a deposit of some importance has been found, containing a mixture of blende and galena, carrying 12 ounces of silver to the ton.

At St. Fabien, in the seigniory of Nicolas Rioux (Rimouski), veins of galena, with sulphate of barytes have also been found, showing ore-bearing thicknesses of 3 to 4 inches. Some work was done on them, and, in a shaft 14 feet deep, two veins were met united, with a partly mineralized thickness of 7 to 12 inches. The direction of these veins is N. 25° W., with an almost vertical dip. According to an assay made at Quebec, the ore contained 60% of lead and only traces of silver. Similar indications have been noted at St. Simon, in the same region.

LAKE TEMISCAMINGUE MINE.

Although known since 1877, this mine, which was the property of E. Wright & Co., has only been worked to some extent since 1886. The property comprises blocks A, B, C, of Duhamel, lot 1 of the IInd range of Guigues (Pontiac) and a part called block D under the waters of the lake. The location of the mine is on the eastern side of Lake Temiscamingue. Although the nature of the deposit which occurs in the Huronian formation, does not seem to be yet well established, it has nevertheless been ascertained to have a thickness of 80 feet at the surface, while its outcroppings have been traced for a distance of 1400 feet in a North Easterly direction. In 1887-88, a shaft of 67 feet (17 × 20) was sunk and a drift of 12 feet (12 × 6) was begun, and from all these workings, which were in full in the ore bed, 2,500 to 3,000 tons, still at the mine, were taken out, so that it will be seen that the mass of ore is considerable.

Different assays have given the following results:

Rev. C. F. Marsan, of the Ottawa College:—At the surface 75% of galena, and in the vein at the bottom, 82%, containing 1721.6 lbs of lead and 26.47 ounces of silver to the ton of 2000 lbs.

Royal School of Mines, London (England):—An assay on 1000 lbs gave 26 ounces, 10 dwts., 1 grn. of silver to the ton.

Geological Survey of Canada:—18 ounces, 229 and 18 ounces 958 of silver.

Other assays have given:

Lead 50%	—	Silver	26	ounces,	7	dwts,	21 grn.
"			23	"	14	"	
"			21	"	17	"	
" 65%			50	"	2	"	7 "

Which warrant the statement that the average grade is 52% of lead and 26 ounces of silver to the ton of ore.

The difficulties of communication appear to be the only serious obstacle to the profitable development of this mine, which is situated at a distance of 100 miles from the Mattawa station, (C. P. R.) itself 318 miles from Montreal. The only channel of transport at present is by the Ottawa river, which is broken by numerous rapids.

In addition to its other property, the firm owns a certain number of wood

lots, ½ West 56, 57, 58, 59, 60, 61, of range I. of Duhamel, and has made a quantity of charcoal in order to reduce the ore on the ground—the mine being equipped with hoisting, pumping and concentrating machinery.

The cost of transport will necessarily be very much reduced when the Lake Temiscamingue Colonization railway (narrow guage) has been completed (1)

LIST OF LOCALITIES WHERE LEAD HAS BEEN OBSERVED

ARTHABASKA—Chester, II, 9, IX, 2, 5, X 19—Craig's road range 11 S
BAGOT—Acton, V, 32
BELLECHASSE—Mailloux, V.
BROME—Potton, XI, 8
CHARLEVOIX—Seigniory of la Côte de Beaupré, (River du Gouffre)
DRUMMOND—Upton, XXI, 51.
GASPE—Cape Rosier—Grande Grève, Little Gaspé.
MISSISQUOI—St, Armand (Cook's Corner).
OTTAWA—Buckingham, IV, 21.
Denholme I., Lead Island.
Wakefield I, 6.
PONTIAC—Calumet Island, IV, ½ W.' 10.
Duhamel, blocks A. B. C. D. (Lake Temiscamingue mine)
Guigues II 1.
RIMOUSKI—Seigniory Nicholas Rioux (St. Fabien).
SHEFFORD—Stukely, VIII, 1
SHERBROOKE—Ascot IV, 15, IX, 9.

(1) The mine has just been purchased by Mr. Th. Wallace, of New York, who proposes to concentrate and smelt the ore on the spot. Borings with the diamond dirll have confirmed the prevalent idea regarding the extent and richness of the deposit. 80 men are presently employed at the mine. By arrangement with the Colonization Railway Company, the Canadian Pacific Railway is also building a branch line to connect Lake Temiscamingue with Mattawa, which will greatly simplify the question of transportation.

ANTIMONY.

Antimony has been only met with at one point in the province, on lot 28 of the Ist range of South Ham (Wolfe) east of the Gosford road. Discovered in 1863, the mine was first worked by the late Mr. Willis Russell, of Quebec. The mineral occurs in the forms of native antimony, sulphide, kermesite (red oxysulphide), senarmontite and valentinite (oxyd of antimony), the two latter being the rarest. The different species are noticeable in blueish quartz veins cropping out at the surface. The main vein intersects the Pre-Cambrian schists of the region, running in a direction N. E., S. W. to E. W. and sometimes showing a thickness of 2 feet. It has been traced for a distance of half a mile and portions are visibly mineralized even on the surface in thicknesses of 3 to 4 inches. The thickness and richness of the vein varies as you descend, the quartz being sometimes permeated with the acicular crystals of the sulphides and the mineral at others being bunched or concentrated in rich pockets, some of which, struck in shafts 1 and 2 of the old workings, showed—it is said—as much as $2\frac{1}{2}$ feet in thickness. The recent works appear to us to have established the fact that, at a depth of 100 feet, the quartz vein has a thickness of 6 feet. According to the assays made and the opinion of experts, the mineral extracted will average 5%. There was an idea that the antimony was disseminated through the slates and that it might be possible to work a portion of the mountain; but our opinion is that the ore is carried in well defined veins of quartz increasing in depth and sometimes richly mineralized. The workings consist of two shafts of 60 and 100 feet respectively, located at a distance of 40 feet from each other and connected at the bottom by a drift, which has been prolonged for 70 feet along the vein. In 1886, the present proprietor of the mine, Dr. J. Reed, had an adit driven in from near the bottom of the hill to a distance of 380 feet, striking the 100 feet shaft, cutting the antimoney-bearing strata and following them for a small distance. In addition to these works, two open cuttings made by the former owner, and again exposing the main vein and a few small branches, should also be noted. Quite lately too, another vein has been observed on the hill, with a mineralized thickness of 3 inches.

It is said that, from the old workings, 180 tons of the mineral were extracted and shipped. Since then no regular work has been done apart from the driving of the adit just referred to. and only a few men have been employed to keep the mine in order.

With a view to enriching the ore on the spot, concentrating works run by steam and consisting of a battery of 5 stamps, &c., were erected, and, though unused for a long time, are still maintained in good condition. The mine, in fact, is ready to be worked again, at any moment, no pumping being needed down to the 100 feet level, which is drained by the adit. It is situated at a distance of 10 miles from Garthby station (Q. C. R.)

The consumption of antimony is very limited, its principal employment being in the manufacture of printing types and in some other alloys, but its selling price is still pretty high—almost 25 cts. per lb.

NICKEL.

Nickel has so far been found only at one point in the province—on lot 6 of theXIIth range of Orford (Sherbrooke) where it occurs in the form of millerite or sulphuret of nickel in small grains and prismatic crystals in rock composed of a mixture of calcite, white pyroxenite and green chrome garnet. Towards 1861, the "Orford Nickel and Copper Co." did some work on the mine. The millerite holds 60% of nickel, but the bulk of the mineral does not yield more than 1%, which is not enough to render it paying. Many of the serpentine and magnesian rocks of the Eastern Townships also contain nickel, but only in traces.

The "Geology of Canada, 1863," notes the existence of a vein of quartz in the XIth concession of the seigniory of d'Aillebout (Joliette), containing iron pyrites and giving to analysis 0.55% of oxide of nickel.

It is not to our knowledge that any cobalt has been found in the province.

GOLD. [1]

HISTORICAL SKETCH.

The existence of gold was first noticed, in 1835, in the valley of the Chaudière; but the practical discovery of the precious metal only dates from the year 1846. Following this discovery, which was purely accidental, Mr. Charles de Lery secured from the Provincial Government, by letters-patent, on the 18th September, 1846, the exclusive right to mine and work for gold in the seigniory of Rigaud-Vaudreuil. (Beauce) Associated with Dr. James Douglas, of Quebec, he began some surface washings on lot 75 of the 1st range North-East of the Chaudière, established the presence of gold in notable quantities, and obtained even some large nuggets. In 1847, the "Chaudière Mining Co." worked a portion of the bed of the river des Plantes and secured small quantities of the metal. In 1851-52, the Canada Mining Co." undertook regular operations, with good results, on the gravels of the river du Loup at St. George. Subsequently, these companies abandoned their works, and down to 1863 gold-seeking in the region was left to the exertions of individual miners or parties of miners, who carried it on by panning or other primitive methods in the river beds, some of them making extraordinary finds. From this last date, however, the gold mining industry may be said to have taken a fresh start; there was a rush of miners to Beauce, and their efforts were chiefly concentrated on the river Gilbert, on lots 16, 17, 18, 19, 20 and 21 of the deLery concession,where they secured excellent results by means of a relatively rude system of working.

In 1864, a company, formed under the name of the "De Lery Gold Mining Co.", leased from the seigniors the right of searching and working for gold in the seigniory of Rigaud-Vaudreuil during thirty years, which lease holds good to the 9th September, 1894. With a view to work the quartz, this company erected a 10 stamp crushing mill still existing near the Devil's Rapids on the Chaudière, which does not appear, however, to have yielded satisfactory results as it only worked a very short time. Then legal difficulties arose between the companies, the miners and the private owners of the surface, the latter refusing to any longer recognize the validity of the De Lery patent, and, during this period, the

(1) Report of the Geological Survey of Canada 1863-1866. Reports of the Quebec Commissioner of Crown Lands 1867-68-69-70-71-72-73-74-75-76-77-78-79-80-81-82-83. Beauce Gold Mines (*Mines d'or de la Beauce*) by W. Chapman.

development of the industry was checked by lawsuits and material obstacles of all kinds.

In 1865, the "Reciprocity Co." leased from the De Lery Company its mining rights on the Gilbert, but met with little success. At the same time, the De Lery Company also leased certain portions of its territory on the Gilbert to groups of miners, whose surface workings, though only consisting of open excavations from 10 to 20 feet deep, and conducted separately, without method or regularity, nevertheless yielded relatively large quantities of the precious metal.

In 1867, M. W. P. Loekwood (1) acquired a "claim" of about half an acre in superficies on the Gilbert, and thenceforward began to systematically investigate the nature of the auriferous deposits and to steadily increase the area of his property by the acquisition of additional territory until in 1873 his rights extended over 18,000 acres, forming sections 3, 4, 7, of the seigniory of Rigaud-Vaudreuil and covering especially the river Gilbert and its affluents. These three sections comprised the concessions St. George, St. Gustave, St. Gaspard, (from lot I A to 7 inclusively) St. Charles (from 1 to 41 B) and the 1st range N. E. (from 43 B to 83 B.)

In 1867-68 Mr. Lockwood organized the "Canadian and North West Land and Mining Co." (limited) of which he was the principal shareholder; but this company went into voluntary liquidation in 1871 and in 1873, he succeeded in forming a new company called the "Gilbert and Chaudière Gold fields Mining Co. of Canada," which became the following year the "Chaudière Gold field Co. of Canada." During these five years (from 1867 to 1873) Mr Lockwood carried out a large number of important works, including some fifty pits or shafts in the valley of the Gilbert, especially from lot 15 of the De Lery concession to lots 74 and 75 of the 1st range North-East, seeking by these works, and by his reports, to establish the exact nature of the deposits, as well as to trace the origin of the gold in them. During this period, gold digging was carried on by few other miners.

The new company continued operations, under Mr. Lockwood's management, until 1876, but, in the beginning of 1877, the plant was destroyed by fire and operations were suspended. About this time, too, troubles broke out afresh between the company, the owners of the soil and the Government, the latter having adopted the policy of issuing licenses to work small dimension "claims." Profiting by these licenses, a number of private miners and small companies took out a good deal of gold, among others the "St. Onge Company," which worked with success on lot 11 of the St. Charles concession, while the Lockwood company was working lot 12 of the same concession. Subsequently, the St.

(1) Sessional Papers, Quebec Legislature, 1889, Vol. 22. III.

Onge company disposed of a portion of its rights to the Messrs. McArthur, of Toronto.

In 1878-79, Mr. Lockwood formed the "Canada Gold Co." represented by Mr. J. N. Gordon—its territory comprising the whole of lot 12. During all this time, lawsuits and struggles were going on for the possession of the richer auriferous properties, which had been occupied without the authority of the owner of the mining rights, the De Lery company, and in 1881, to endeavor to put an end to these obstructions to the development of gold mining, the Provincial Government undertook to contest the validity of the De Lery patent in the law courts and took action to have it set aside as illegal, null and void. On the 22nd June, 1883, the Superior Court dismissed this action and recognized the validity of the title and, in 1884, this judgment was confirmed in appeal.

The Mining Act of 1880 regulated the conditions of work on Crown as well as on private lands, maintaining at the same time the 2½ per cent royalty on the gross weight of all the gold and silver collected. Under the provisions of this law, a few companies undertook to work, such as the "Aimsworth Co." on lot 13 and the "Beauce Mining and Milling Co." on lot 14 of the De Lery concession, and operations were also resumed on the lots 6 to 10 of the St. Charles concession, 74 to 76 of the 1st range N. E., 30 of Chaussegros and 16 and 17 of De Lery. On these properties, the old companies had done some work, which was continued by the new companies, in most instances, without the authorization of the De Lery Company, whose title was in dispute at the time.

Finally, the question of the validity of the patent was definitely settled by the judgment of the Court of Appeals, in December, 1883. As has been, seen, the principal workings had been carried on in the seigniory of Rigaud-Vaudreuil and especially on the Gilbert, which was the chief centre of activity. In other parts of Beauce, however, there had been a good deal of prospecting and exploring of streams. In Ditton (Compton) the Pope company had been working regularly and taking out large quantities of gold without obstruction, their title being indisputable. Towards 1881-82, a company, under the management of Mr. A. A. Humphrey, endeavored to work the extensive surface alluvions on the river du Loup, at Jersey Point, near the confluence of that stream with the Chaudière, and to wash the gravel by the hydraulic process, and built a flume, 20 miles in length, and with a head of 150 feet of water. But, for a variety of reasons too long to be here detailed, this enterprise proved a failure and the works were abandoned, after washing only a portion of the gravel.

During late years, some work was done by the St. Onge Bros on Slate creek (Ruisseau de l'Ardoise) near St. George, where a shaft was sunk to a depth of 165 feet. Some important prospecting was also done by small companies and

associations represented by Mr. H. Sewell, on the river des Plantes, by Captain Richards on Cumberland creek, by St. Onge Bros, on the Famine, and by Messrs Coupal & McArthur on Des Meules creek (Ruisseau des Meules). This firm is the only one, which is still working to some extent, as detailed further on.

ALLUVIAL GOLD.

At the outset of the gold digging operations, the alluvial gold was only sought for in the river beds and flats, but, later on, the important fact was recognized that, to prosecute the search with success, it should extend down to the old river channels buried many feet below the present level. The investigations made by Mr. Lockwood and by the engineers and geologists sent out by the companies which be organized have proven beyond question the existence and value of one of these old channels in the valley of the Gilbert and have even determined the conditions of its existence, its dimensions and the mode of working it. In getting down to it, the successive strata passed through beneath the surface deposit were a layer of slightly auriferous gravel, blue clay, very fine quicksand and, lastly, the gold-bearing gravel, in a thicknessof not more than 5 to 6 feet and the lowest depth of which, lying on the bedrock and varying from 1 to 1½ feet thick, is the only rich portion worked. Underneath this gravel the bedrock is composed of slates, often disaggregated for a depth of two to three feet, which are also removed and washed, as they often hold gold in their cracks and fissures. For the purpose of reaching these strata shafts were sunk to 30,50 and sometimes to 80,100 and even 165 feet. The sinking of these shafts is a costly and difficult work, as blue clays, fine sands and frequently quicksands have to be passed through, necessitating a great deal of staunch and solid timbering and constant pumping. Operations in the gravel are then conducted by means of drifts, which have also to be carefully timbered. In the first place, the barren material overlying the auriferous gravel and the boulders or large stones mixed with the latter are removed and left in the mine, and the pay dirt is then hoisted to the surface to be washed. When the limit of the bed has been reached in a transverse direction, these drifts are then filled up with the barren stuff and the boulders left in the mine.

The pay gravel is washed in sluices by the ordinary processes, but. in a large number of the old workings, a certain amount of the fine gold was lost by the primitive methods of the early miners, washing with the pan or the rocker.

As already stated, the special nature of the ground necessitated constant pumping, but, where the lay of the land permitted, tunnels were made to drain the mines and gave excellent results.

In certain parts of the district, and especially at the confluence of the rivers

Chaudière and du Loup, extensive deposits of alluvial gravel occur on the surface, the washing of which was tried by the hydraulic process consisting in the breaking up of the gravels with the aid of a powerful jet of water. About 1881-82, a company, under the management of Mr. A. A. Humphrey, built a flume 20 miles long, which gave a head of 150 feet of water, but it worked only a short time. The hydraulic process, in fact, does not seem to have yielded satisfactory results, as the company had to suspend operations, notwithstanding the extensive works it had carried out at Jersey Point.

The Beauce auriferous region covers a very extensive area, estimated at 15,000 square miles, embracing the valleys of the rivers Chaudière and du Loup and of their tributaries and stretching from St. Joseph in the province of Quebec to the American boundary line. But the scene of the most important and extensive workings for the precious metal has been the Gilbert river, whence also the greater part of the gold recorded as having come from Beauce has been extracted. Some very large sized nuggets have been found, the biggest weighing 71 ounces, others 52 and 51 ounces and a large number respectively worth several hundred dollars.

Mr. W. P. Lockwood (1) has especially contributed by his working and perseverance during 23 years to practically prove the wealth of the region. Either by himself or by the companies due to his organization, upwards of 40 shafts were sunk from lot 15 of the De Lery concession to the Chaudière, or over a distance of about three miles, thus proving the continuity of the auriferous deposit. Mr. Lockwood claims that, by the showing of these works, the amount of gold in this bed was at least $50,000 to the acre, that, in certain portions, it might even attain $60,000 to $100,000, and that, from an area of 10 acres on lots 15 to 20 of the De Lery concession over a million of dollars worth of the precious metal was taken out. Moreover, the numerous reports which we have consulted on the subject are all very conclusive as to the richness and continuity of the deposit.

Some other workings on the rivers Famine, des Plantes and Chaudière have established the existence in those localities of similar deposits. In addition, it may be said that the presence of gold has also been noted in nearly all the brooks and rivers of the region and notably on the following: Le Bras, Mill, des Meules, Raccourci, Bertrand, Poulin, Veuilleux, Loubières, Bolduc, Caron, Gosselin, Cumberland, Stafford, Pozer, Abenakis, Metgermette, Traveller's Rest, du Portage, Samson, Grande Coudée, &c., all of which have been explored by different parties of miners.

The gold in Beauce holds a small proportion of silver, which may amount to 10 or 12%. The presence of mercury, in small quantity, frequently forming an

(1) Lockwood reports to the Crown Lands Commissioner, P. of Q.

amalgam on the surface of the precious metal, has also been noted, as well as some grains of platinum containing traces of those rare metals, osmium and iridium. The analyses of the Geological Survey of Canada show that, in the specimens assayed, the proportion of fine gold amounted to 871, 892, 864, 867, per thousand.

It seems now to be well established that the source of this alluvial gold is local and that it has been derived from the quartz veins traversing the Cambrian slates of the region. (1) In fact, as hereafter shown, these quartz veins are nearly everywhere gold-bearing and as further proof that they have been the source of the alluvial gold, pieces of the latter have been frequently found still attached to the quartz. It has also been remarked that the alluvions adjoining the quartz veins are generally very rich. All these facts, coupled with the coarseness of the gold, naturally lead us to the conclusion that the precious metal has not come from very far off. Geologists, moreover, note a remarkable analogy between this region and the gold fields of Nova Scotia, where the auriferous quartz veins are successfully worked. There is therefore room to hope that attention will also be paid to the quartz veins, whose working is attended with less uncertainty.

It is very difficult, if not impossible, to estimate the exact qnantity of gold that has been produced in the province on account of the uncertainty and irregularity of the reports of the companies. We give, however the figures of the production as derived from the reports of the Crown Lands Department, which are the only official returns extant:

			Weight.			Value.
1867						$31,000 00
1868	1st	quarter	303	ounces	0.23	
	2nd	"	432	"	12.7	8,100 00
	3rd	"	336	"	17.12	
	4th	"	324	"	16.23	
1870	1st	half	1,455	"	16.13	
1876-77			382	"	17.14	
1877	2nd	half	698	"	19.12	
1878	1st	"	246	"	16.3	
"	2nd	"	....			13,617 75
1879	1st	"	....			15,469 63
"	2nd	"	....			17,502 22
1880	1st	quarter	228	"	8.	1,047 00
	2nd	"	634	"	6.22	10,432 92
	2nd	half	....			33,174 00
1881			....			56,375 31
From 1st April 1879 to 20th Sept. 1883			7,902	"	2.4	40,262 30

(1) Report Geological Survey, Canada, 1887.

Making a total of 12,956 ounces, 14 dwts, 13 grs, which, at $17.50 per ounce, give $226,743, to which we add, for the weight of the yields not given above. $31,000 + 13,617.75 + 15,469.63 the whole forming a total of $279,095.38.

It will be remarked that there are no returns down to 1867, nor for the year 1869 nor for the years comprised between 1870 and 1876 and, again, between 1883 and 1890 inclusively, while the quantities of gold taken out at Compton are also not given, Moreover, a good deal of work was done on properties in litigation, from which the output could never be ascertained. It will consequently be readily understood that the above total is very much below the figure of the real production, which is a fact, moreover, repeatedly admitted in the reports of the inspectors. In the opinion of several competent persons, the total of the gold collected in the province would amount to not less than two millions of dollars' worth.

Nuggets of remarkable size have been found on the Gilbert. The biggest weighed 71 ounces. One also of 52 ounces 11,892 (the Kilgour nugget) and several of about 50 ounces were picked up, as well as others worth several hundred dollars each. In examining the reports of the companies, we also remark that they mention the extraction of large quantities of the precious metal from small surfaces, for instance:

The "Canada Gold Company," from a single acre	$65,000 00
James McRae, from 100 square feet	50,000 00
The "St. Onge Co." took out an average per man per day, during two years, of	3 50
The Poulin Brothers, with the pan, in one day	1,200 00

It is claimed that the workable surface of lots 16 to 21 of the De Lery concession on the Gilbert yielded alone not less than $700,000 worth, the practical production of the gravel being about $2.25 of gold to the cubic yard.

All these facts point to the great importance and wealth of the auriferous district of Beauce and it is therefore much to be hoped that every obstacle to its free development may be removed. As already remarked, numerous obstructions arose at the very moment that the miners were flocking into the district with the most ardor. The impetus of the industry being thus checked, companies and individuals retired discouraged from the struggle, and the bad reputation thus acquired has survived the settlement of the legal difficulties to such an extent that, even to day, these mines are still abandoned.

Experience has, however, proved that, to be profitable, the work, on account of the attendant difficulties, must be done by wealthy companies, with a suitable extent of ground, in the possession of which they must be assured for a sufficient time.

THE COUPAL, McARTHUR MINES.

This mine is situated at a distance of one mile south of the village of St Francis, on lot 45 of the 1st range South-West, on the left bank of the Mill stream and its tributary, the des Meules creek.

The auriferous layer, which appears to be the old bed of the des Meules creek, has been struck at a depth of 80 feet by a shaft which traverses the slates and connects with it by a small drift. The draining of the mine is effected by means of a tunnel of 500 feet, extending to the Mill stream. The strata passed through in sinking the shaft to reach the gold-bearing gravel offered in this case much greater difficulty than at other mines. They appear to have been the following:

Vegetable soil.	
Clay and boulders	30 feet.
Fine white sand mixed with boulders	20 "
Blue clay	10 to 15 "
Hard gravel	10 to 12 "
Fine quicksand and water impossible to keep out	10 to 12 "
Auriferous gravel.	
Slates (bed rock.)	

The width of this basin is about 100 feet, and the paying or workable part 25 feet. The depth of the gravel is very slight, the gold occuring nearly always in the fissures of the bed rock, the stratification of which runs in about the same direction as the auriferous deposit. The same basin has been traced for a distance of a mile by means of three other shafts and the tunnel by which the mine is drained.

The company owns the mining rights on 5,000 acres, but has only worked with a few men for the last three years, a part of this time having been devoted to exploring and preparatory work. It has taken out 275 ounces of gold worth $5,000, the largest nugget secured weighing a little over 8 ounces and being valued at $153. On the occasion of my last visit, in September, 1889, only 4 men were at work in the mine and they estimated that the amount of the precious metal found represented an average of more than 4 ounces or about $100 per 80 square feet. The same company has secured a large tract of land in the valley of the Gilbert and there is room to hope that other important workings will be shortly undertaken there.

"GILBERT AND CHAUDIÈRE GOLD FIELDS CO. OF CANADA"

(Limited, London.)

This company, which is represented by Mr. W. P. Lockwood, is the same mentioned in the preceding historical sketch describing the role he has played in the development of our gold-mining industry. For some years past, it has suspended operations, but has recently entered into new contracts with the De Lery Company, the owner of the mining rights, and is now making serious efforts to resume work itself or to cede to other companies a part of its territory, in which the existence of alluvial gold and numerous quartz veins have been noted.

GOLD IN DITTON (COMPTON.)

Besides the workings in Beauce, the search for alluvial gold has also been carried on in a regular way for twenty years in the township of Ditton (Compton); but the quantity of the precious metal collected, though, no doubt, pretty large, is not known.

These mines, called the Pope mines, after there proprietor, Hon. J. H. Pope, are located on the Little Ditton river and embrace lots 33 and 34 of the IXth range of Ditton. As in Beauce, the gravel rests on raised slates at a depth varying from a few feet to 15 and 20 feet, The entire bed of the stream, as well as its flats, for the length of half a mile, has been washed, with a working force of 10 to 15 men. The largest nugget found was worth $60. For the last five years, Mr. Pope has abandoned operations and permits the miners to work on their own account, without claiming any royalty or rent from them. In September, 1889, three parties of miners, numbering 10 men, were digging on small "claims," and, on one of these, I saw $30 worth of the precious metal, including a piece worth $15, collected in a single day.

Each pan washed on this stream, as well as on the Ditton and the Salmon rivers, shows gold and I was assured that the metal had also been found on several of their tributaries, among others on lots 5 and 6 of the VIIth range of Ditton, and 4 and 5 of the IVth range of Chesham (Salmon river), where some small workings have been begun.

On account of the slight depth of the alluvion covering the pay gravel, these works are easily executed, open pits or cuttings being sufficient and shafts being only rarely needed. Along the stream mentioned, numerous quartz veins have also been noted.

Gold was also found about thirty years ago in the alluvial strips on lots 11, of the XIth range and 2, 3 and 6 of the XIIIth range of Ascot, and 19 of the Vth range of Orford (Sherbrooke) and this gold was partially worked by companies. These properties were then regarded as very important and also contained quartz veins, but their working was not the less abandoned.

The presence of the precious metal has also been noted at several points in the valley of the river St. Francis, but, apart from by the miners already enumerated, it is not to our knowledge that any important work has been done at any point of that region.

QUARTZ.

The quartz of Beauce has as yet been but little worked, the only attempt at development in that direction being the crushing mill established near the Devil's Rapids, on the Chaudière. Whether owing to defective construction of the mill or to other causes, this attempt was not successful—it being even asserted that the mill did not yield up again the free gold put into it as a test, so that this endeavor to work the quartz should be regarded as without significance or bearing on the future possibilities of the quartz-crushing industry. The mill in question, which is provided with 10 stamps, is still standing. In the early days of the alluvial gold workings, great uncertainty appears to have prevailed as to the source of the precious metal, but it seems to be now well established that its origin is purely local and that it has been derived from the decomposition of the quartz veins traversing the Cambrian slates of the region, a theory which is, moreover, confirmed by the coarseness of the gold found, especially in the neighborhood of the quartz veins, as well as by the frequent discovery in the alluvions of pieces showing scarcely any signs of abrasion from rolling and often still adhering to their quartz gangue. Mr. R. W. Ells, of the Geological Survey of Canada, (1887) sums up the question most conclusively in this sense and suggests the advisability of search being made in the vicinity of the anticlinal lines, according to the principle followed in the Nova-Scotian gold fields. Geologists, moreover, find that a great analogy exists between the formations of the two regions.

In the report of the Geological Survey for 1886, there is a report from Mr. A. Michel, accompanied by assays by Dr. T. Sterry Hunt, which established the finding of gold in several veins. Out of 31 specimens assayed, 12 contained gold in the proportion of $5.03 to $15.15 to the ton. Three samples, holding free or visible gold, raised the percentage to $69.07 and $101.29. The same report mentions other assays made at Boston and New-York, which gave heavy percentages of gold, ranging as high as $106 and even $136. These assays are cited

as reliable. The general result of these tests recognizes as gold-bearing the quartz coming from the following lots: Seigniory Rigaud-Vaudreuil, St. Charles concession, 19- 21—De Lery concession, 13, 20—Linière, I, 2, I range N. E. 83-62-59 A 51 A. Chaussegros, 16.

Mr. A. Michel also found a little fine gold in a vein of quartz on lot 8 of the Ist range of Lambton.

According to assays made by Mr. Nagant, of Quebec, on specimens of our own collecting, gold occurs in quartz derived from the following lots;—Marlow, Kennebec range, 79. Metgermette, near Portage lake, range VIII or IX, Linière, near Portage river, II section C., Ditton, (Compton) Salmon river, Free native gold is not frequently visible in the quartz of Beauce; still several veins of this class, the most notable of which is the one traversing the Chaudière at the Devil's Rapids, have been found, in which the precious metal is said to have been distinctly recognized by the naked eye. On Mr. Pope's property in Ditton, a quartz boulder was found showing free gold, from which $600 worth of the precious metal was extracted by breaking alone with a hammer. And credible persons have also asserted that they obtained gold by crushing the quartz in a mortar and then washing it with the pan. The many known quartz veins, however, have been but little worked of late years, the failure of the mill already referred to having prevented any serious effort in that direction on a large scale. Generally speaking, the veins are pretty thick, with a general North-East direction, cutting the stratification at a slight angle. In one part alone of the district of the Gilbert, some 40 have been noted with thickesses ranging from 5 to 12 feet and sometimes from 18 to 25 feet. These veins have been partially traced and their material assayed. They are moreover known under local names, which it is needless to here mention; but it may be stated that several of them have yielded heavy percentages of the precious metal to the assays and that, in the case of some of them, particles of gold were derived from the mere crushing of the quartz.

Numerous quartz veins have also been noted all along the Kennebec road and on the different tributaries of the Chaudière and river du Loup, as well as on the Ditton and Salmon rivers in Compton and a multitude of other places.

Briefly stated, although the quartz veins of Beauce have not yet exhibited free gold except in small quantities, they are not the less gold-bearing and workably so, too. There is also reason to hope for the discovery of really rich veins, taking into account the fact that the alluvial gold has been derived from the quartz, and, in such case, their working would undoubtedly be easy in view of their size and the proximity of means of communication and transport. These quartz veins are therefore worthy of very serious attention and it is much to be

desired that serious attempts should be made to develop them, convinced as we are beforehand that judiciously conducted operations would lead to profitable results.

The fact should also be noted that visible gold has been observed in several quartz veins worked for copper at the Harvey Hill Mines, in the Handkerchief, (Lotbinière) and at Halifax (Megantic), Horton (Arthabaska) and several other points.

GOLD IN THE LAURENTIAN ROCKS.

It is claimed that gold has been found in quartz veins in the rocks of the Laurentides. I have before me analyses which assert its presence, but the specimens of my own collection have not yielded the same result, and workings undertaken opposite Mattawa, in Pontiac, in the vicinity of Buckingham, and in the counties of Joliette, Berthier and Montcalm do not appear to have turned out profitably. Without wishing, however, to deny the possibility of the existence of auriferous quartz, I must still say that it is not to my personal knowledge that any has been found in that region of the province of Quebec. Nevertheless some assays of pyritous Laurentian rocks made by Mr. H. Nagant appear to have detected traces of gold, which in that case would exist in the magnetic pyrite.

In the report of the Geological Survey of Canada for 1878-79, an analysis is recorded of a very small specimen of quartz mixed with apatite and iron pyrite, and showing native gold, which gave 11 ounces 725 of the precious metal, and 52 ounces 333 of silver to the ton of 2000 lbs. Several other localities in Wakefield (Ottawa) and in the county of Pontiac, are also mentioned as gold-bearing, but this statement is confirmed by no precise information.

LIST OF THE PRINCIPAL LOCALITIES WHERE GOLD HAS BEEN FOUND.

ARTHABASKA..Horton II, 17½ S W.

BEAUCE.....Lambton A 1, 8.

Linière—River Metgermette, East branch, 1, 2, 3, 4, 5, 6, 7, 8, 9. River Metgermette, North branch 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12. River Travellers' Rest 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14. River Portage 1, 2, 3, 4, 5, 6, 7, 8.

Marlow—Kennebec road range A East, A West. V½ N. W. of ½ S. W. of 1, VI 1, VII 1.

Metgermette North—River Metgermette, East branch, 10, 11, 12, 13, 14, 15, 16. River Metgermette, North 13, 14, 15.

Mergermette South—River Traveller's Rest 8, 9, 10, 11, 12, 13, 14, 15, 16, River Portage, 9, 10, 11, 12, 13, 14, 15, 16. VIII, 13, 14.

Risborough—XIV, 1, 2, 3, XV, 1, 2, XVI ½ S. W., 1. River du Loup 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13.

Seigniory Rigaud-Vaudreuil—(The gold mining rights have been ceded over the whole seigniory) De Lery concession 13, 14; 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27. St. Charles concession 6, 7, 8, 11, 12, 13, 19, 21. 1st range N. E. 8, 9A, 9B, 42, 43A, 47A, 48. I range N. E. 49A, 56, 57. 62, 63A, 63B, 75, 76. Chaussegros concession 29, 30. Fraser concession S. E. 43, 44, 45, 46. St. Gaspard concession 37, 38. I range S. W. (44A, 44B, Coupal & McArthur) 55B. Ste. Catherine concession A, B.

COMPTON.....Chesham—III, 6. IV, 4, 5.
Ditton—VII, 5, 6. IX, 23, 24. X, 34½N.

DORCHESTER...Watford—III, 5, 6. IV, 2, 3.

LOTBINIÈRE...Seigniory of St. Giles de Beaurivage—Handkerchief concession.

MEGANTIC.....Ireland—V, 11.
Leeds—XIV—, 14.

SHERBROOKE..Ascot—XI, 11. XIII, 2, 3, 6.
Orford—V, 19.

This list is incomplete as regards Beauce, where gold has been found in nearly all the streams and brooks flowing into the river du Loup and the Chaudière.

SILVER.

No mining for silver is carried on in the province, although that metal has been frequently found associated with other ores. Thus, for instance, without alluding to the ores of galena, which always contain more or less of it, the copper ores of the Eastern Townships carry silver, as already stated in the chapter on copper, and sometimes even in pretty considerable proportion, especially when the galena is mixed with copper pyrite, as in Acton, Ascot and Upton, where compounds have occasionally been met with rich in silver and even in native silver, but in small quantity. Only one mine may be classed as a silver mine. It is the one situated in Marlow and Risborough (Beauce), of which a description is subjoined:

ARMSTRONG & CO. (1)

This property is situated in the county of Beauce, on lots 1 of the VIth range of Marlow, 2½ N. E. and 3 of the XIVth range, 1½ and 2 S. E. of the XVth range and 1½ S. W. of the XVIth range of Risborough.

The following information relates to this mine, which we have not had yet occasion to visit. Its discovery occurred about 1880, when some prospecting work was all that was done.

From 1885 to 1887, more important works were undertaken, establishing the existence of a number of veins, of which four are well defined and exhibit thicknesses ranging from a few inches to a foot and, even in one case, to two feet. A portion of these veins run from East to West, dipping almost vertically and comprising sandstones and slates of the Cambrian formation. The others are regarded as cross veins in a perpendicular direction and a dip 45° East. All these veins have been traced for distances of from 500 to 1800 feet, by means of surface workings and shafts of 27, 18, 6 and 8 feet in depth. They are composed of quartz with iron and copper pyrites, blende and galena, the mineralized parts forming from one third to one half of the veins.

(1) Geological Survey of Canada, 1887-88.

The works done so far have been only of an exploratory nature to prove the continuity of the veins.

Several assays of the ore have given the following percentages of silver per ton of 2000 lbs of the mineral :

Rev. E. Page, professor, Laval University	430	ounces
do do do	260	"
Prof. R. H. Richards, Boston	28	"
do do	30.7	"
Canadian Geological Survey	43.663	"

Some other assays have detected traces of gold. The mine is situated at a distance of 8 miles from the Kennebec road, and about 50 miles from St. Francis Beauce (Q. C. R.)

NATURAL COMBUSTIBLE GAS[1]

The existence of natural gas in various parts of the world has been long known, but its utilization on a large scale for industrial purposes only dates from 1882-83, when it was first brought into notice in that way, in Pennsylvania, in the United States, and since then the development of the industry has been so great as to render its present importance very considerable.

In the province of Quebec the presence of this gas has been noted, for many years, in the valley of the St. Lawrence, and especially in the vicinity of Louiseville. It has also been observed at the following points: Chambly, Maisonneuve, Longue Pointe, Varennes, St. Barnabé, Contrecœur, St. Henri, L'Epiphanie, St. Paul, St. Cuthbert, St. Léon, Ste. Anne de la Pérade, Québec, (Hare Point), L'Acadie (near St. John's), St. Sulpice and St. Barthélemi.

In the month of August, 1880, Messrs Piret and Genest, of Three Rivers, sunk the first well near the village of St. Maurice (St. Alexis range) through 54 feet of blue clay and gravel following a sort of pipe or conduit of hardened clay, which is still preserved in the Geological Museum at Ottawa. At that depth, however, they reached the Trenton limestone, without going further.

In the neighborhood, in the same St. Alexis range and in the St. Martin range, farmers, putting down water pipes to depths ranging from 40 to 60 feet, frequently noticed abundant escapes of gas, accompanied by sulphurous water.

In the same year, 1880, the abbé Laflamme read a paper on the subject at Louiseville by the light of gas procured in the vicinity and thus proved the possibility of utilizing this natural resource.

In 1883, Messrs Renaud Brothers and Dubois made a boring to the rock, a depth of 70 feet, on their property (No 3 of the cadastre of St. Henri de Mascouche). They obtained a strong flow of gas, but the lack of means compelled them to discontinue work.

In 1885, Mr. Poirier, of St. Grégoire, (Nicolet) organized a small company; a boring was effected under favorable conditions on Mr. H. Trudel's property,(number 501of the concession of Beauséjour). The boring was pushed as far down as eleven hundred and fifteen feet, and a fair quantity of gas was obtained from different depths, as shown in the following statement:

(1) Report of the Commissioner of Crown Lands, 1887.

From 0 to 75 ft.....	75 ft.	Clay and sand with some veins of inodorous gas and water.
" 75 to 215 ".....	140 ft.	Sandstone, somewhat calcareous.
" 215 to 640 ".....	425 ft.	Red and brown schists, soft, with abundant emanations of gas, with the odor of kerosene at 316, 370, 580, 640 feet, the 580 feet vein being the most productive.
" 640 to 820 ".....	180 ft.	Impure limestone, oily beneath. a vein of gas at 820 feet.
" 820 to 1115 ".....	255 ft.	Black schists, compact.

According to the latest information received, the gas is still flowing.

Finally, during the session of the Quebec Legislature, in 1886, a Canadian company, under the name of the "Combustible Gases Company" and the presidency of Mr. Cyrille Duquet, of Quebec, secured from the Provincial Government the exclusive right of working and utilizing natural gas in the province of Quebec for a period of 10 years, and, during the session of 1887, this period was extended to 15 years.

In 1887, this company made a boring of 1500 feet at Maisonneuve near Montreal and four others of 500 to 600 feet at Louiseville (Maskinongé). Gas was struck in pretty fair abundance by all these workings, and was even made use of down to the present year to heat the steam-boilers of the Louiseville water works company.

The following is a statement by Abbé Laflamme, of the geological sections of the gas wells of the province :—

No. 1. WELL AT MAISONNEUVE (1,500 feet.)

Superficial drift				
Utica shales		at	76	feet.
Trenton formation.	Limestone	"	160	"
	Gas	"	270	"
	Gas	"	400	"
	Limestone and shale	"	"	"
	Salt water	"	630	"
	Limestone	"	"	"
	Limestone and petroleum-bearing shale	"	"	"
	Limestone and iron pyrites	"	"	"
	Gas and sulphurous water	"	1150	"
	Pure limestone	"	"	"
	Arenaceous limestone	"	"	"

WELLS AT LOUISEVILLE.

		(No 2, 545 ft.)	(No. 3, 295 ft.)	(No. 4, 695 ft.)	(No. 5, 300 ft.)
Superficial drift					
Utica shales		125 ft.	165 ft.	160 ft.	"
Hudson River and Utica formation	Gas and salt water	210 "	220 "	210 "	"
	do	260 "	295 "	260 "	"
Trenton limestone				350 "	"
Sandstone					

No. 5 is distant 150 feet from No. 3 and presents the same conformation.

WELL AT ST. GREGOIRE, (1,115 feet).

Superficial drift		
Calcareous sandstone		at 75 feet.
Gas		" 316 "
Medina red shale	Gas	" 370 "
do	Gas	" 380 "
Hudson River formation.	Impure magnesian limestone	" 640 "
	Black shale	" 820 "

In his summary report of 1887, Mr. A. R. C. Selwyn, director of the Geological Survey of Canada, says on the subject of gas and petroleum: "*I consider that the probability of such reservoirs existing on the South shore, in the country between Lake St. Peter and St. Hyacinthe is very great, especially along or in proximity to the central part of the line indicated by Sir W. E. Logan as the course of the Deschambault anticlinal.*" And, elsewhere, he adds: "*In any case the question may certainly be regarded as one of great importance in comparison with the small amount of money which would be required to thoroughly test it.*'

In 1863 and 1866, Sir W. Logan and Dr. T. Sterry Hunt intimated the possibility of finding petroleum in the Trenton limestone.

Measured in 1887 by Mr. Coste, the well at St. Grégoire yielded at the rate of 50,000 cubic feet of gas per 24 hours and it was further ascertained that, after being closed for an hour, it gave a pressure according to the manometer of 350 lbs to the square inch.

A glance at the geological map of the province will show that the valley of the St. Lawrence between Quebec and Montreal is formed of Trenton limestone, overlaid by Utica, Hudson River and Medina shales, the whole buried under a superficial layer of alluvium averaging 50 to 80 feet thick, but occasionally attaining as much as 120 and even 160 feet. At several points along the North

shore, these formations outcrop and are visible at the surface, but they are usually overlaid by alluvial deposits. We are in possession of but little information as regards the South shore, where these formations are possibly covered up by other strata. But there is no question that, in the region south of Three Rivers, red shales have been observed, which appear to belong to the Medina formation. The borings at St. Grégoire were undoubtedly made through similar shales and the Trenton limestone had not yet been reached. The geological formation of the South shore, as indicated on the map, is somewhat hypothetical, owing both to the absence of borings and the thickness of the alluvial layer. It may, however, be asserted that the formation comprised between Quebec and Montreal and extending over 50 to 60 miles to the Southward very likely contains gas and petroleum.

Most geologists admit that natural gas has its origin in the decomposition of animal and vegetable organic remains, the accumulation of the remotest geological ages. Others, but in less number and belonging especially to what is termed the practical class, hold that the gas is continuously produced by chemical action in the bowels of the earth.

The first theory would lead to the belief that the solid, liquid and gaseous mineral combustibles have a common origin, through the production by decomposition of different results in vegetable or animal matter. Under such circumstances, gas and petroleum would be indigenous to the rocks in which they are found and their quantity would therefore be limited and subject to exhaustion, as is the case with all other mineral deposits.

The advocates of the second theory hold that the superficial or sea water, reaching great depths by infiltration, comes in contact with native metals at high temperatures and there, in presence of carbon, and under strong pressure, is decomposed, oxydizing the metals, forming hydrocarburets and passing off into the higher parts, where they find outlets and porous rocks to absorb them. According to this theory. the quantity of gas would be inexhaustible, since it would be formed unceasingly as in a great laboratory.

The American companies operating in this gas rely as a rule, on the first of these theories and anticipate the day when the supply will be exhausted. Adopting the first hypothesis, the American geologists sum up as follows the conditions under which workable accumulations of gas are likely to exist.

1o The rock must evidently contain organic remains.

2o It must contain porous strata fit to contain oil or gas.

3o It should be impermeable both above and below and should present neither fissures nor chinks.

4o It must be wrinkled and present elevated parts where the gas may collect.

The same geologists lay down the principle that, whereas the oil and gas have a common origin, they may be found in the same regions in variable proportions.

Under the second theory, such accumulations of gas may be found in any region where certain strategraphical conditions obtain.

As far as our province is concerned, these conditions seem to exist, at least on the South shore of the St. Lawrence.

In the United States (1), natural gas is used extensively in several States and especially in Pennsylvania, Ohio, Indiana, New-York, &c.

Natural gas is also met with in the province of Ontario (Canada), where its discovery for industrial purposes is especially due to Mr. E. Coste.

No analysis of the natural gas of this province has yet been made ; but for information sake, we append an analysis of the Pittsburg (Ohio) gas made by Mr. S. A. Ford, chemist to the " Edgard Thomson Steel Works Co." and considered as indicating the average composition :—

Carbonic acid	0.6
Carbonic oxide	0.6
Oxygen	0.8
Bicarbureted hydrogen (Olefiant gas)	1.0
Ethylic hydride	5.0
Protocarbureted hydrogen (Marsh gas)	67.0
Hydrogen	22.0
Nitrogen	3.0
	100.
Heating power	789,694

1,000 cubic feet of this gas weigh 38 lbs and have a heating power of 210,069,604 units.

The same heating power is obtained from 57.25 lbs of pure carbon, 62.97 lbs of coke of 90 per cent of carbon, 54.4 lbs of bituminous Pittsburgh coal or, in

(1) "The geologic distribution of natural gas in the U. S." Ch. A. Asburner ; Preliminary report on Petroleum and Gas : E. Orton.—Reports of "Geological Survey of Pennsylvania and Ohio." There have been many other publications on the petroleum and gas of the U. S. and a Pittsburg newspaper "*The Iron Manufacturer*" has published very important supplements on the gas.

other words, one ton of coal of 2,000 lbs would be equivalent to 36,764 cubic feet of gas. These are theoretic figures, but it may be admitted, practically, that one pound of coal is equal to 7½ cubic feet of gas.

The gas in a dry state has a specific gravity of 0.520 compared with air; if saturated with water, its density is 0.554.

Mixed with nine to fourteen times its volume of air, it explodes violently.

According to Professor C. C. Howard, of Columbus, the Findlay district (Ohio) gas is composed as follows:

Protocarbureted hydrogen	92.61
Bicarbureted hydrogen	0.30
Hydrogen	2.18
Nitrogen	3.61
Oxygen	0.34
Carbonic acid,	0.26
Carbonic oxide	0.50
Sulphuretted hydrogen	0.20
	100.
Heating power	878,082
Specific gravity	0.57

The presence of the sulphuretted hydrogen imparts to the gas of this district a disagreeable smell, which does not characterize the Pittsburg gas.

In the United States, natural gas is used for domestic heating, but little for lighting. Industrially, it is employed for the generation of steam, for open hearth melting in the manufacture of steel, as well as in iron puddling and heating furnaces, glass works, pottery, brick and limekilns, &c., &c. It is also used instead of steam or compressed air for machinery in the open air.

Its price is usually based on the corresponding price of coal, but, in some districts, it is very cheap and is not even measured.

Wells have been found producing 15 millions of cubic feet of gas per 24 hours, with pressures of from 800 to 900 lbs to the square inch in the closed pipe,

According to official statistics, this gas, in 1885, replaced 3,131,600 tons of coal worth $4,857,200,; in 1886, 6,453,000 tons worth $10,012,000; and in 1887, 9,867,000 tons worth $15,838,500.

The supply of natural gas is not considered inexhaustible, but the plant and piping could be utilized for artificial gas manufactured in large quantities and at a low price, and already important companies have been established for this purpose.

In the province of Ontario, very productive wells have been sunk in a region geologically later than that of this province.

I have no doubt whatever that judiciously and properly conducted borings would lead to the discovery in this province of important reservoirs of gas and probably also of petroleum.

PETROLEUM [1]

Although no search has yet been made for petroleum in the central portion of the province of Quebec, it is nevertheless our opinion that it should be found in the Trenton formation, especially in the Southern section of the valley of the St. Lawrence.

In the Geology of Canada, 1863, Sir W. Logan, says: "The possibility of its occurrence in available quantities in some part of the Trenton formation should not be lost sight of." In the Geological Survey's report for 1866, Dr. T. Sterry Hunt uses the following language: "The limestones of this formation may, in some localities, prove to be valuable sources of petroleum." Subsequent facts have confirmed the opinion of these two eminent geologists, especially since the discovery of the vast oil fields of Ohio, Indiana and Kentucky in the same formations as those in which natural gas has been disoovered. In the province of Quebec, small cavities filled with petroleum have been found at the points where these formations outcrop, as at Pointe aux Trembles and river à la Rose (Montmorency) near Quebec. It frequently occurs, too, that certain beds of Utica shales, in the same formation, are so impregnated with the oil as to burn freely. This fact has been observed at Pointe Bleue and Pointe aux Trembles on Lake St. John, and, as a further instance of it, it may be stated that Traverse island in the same lake was on fire for a whole season. We shall not dwell at any further length on this subject, preferring to leave to the future the task of realizing our anticipations.

PETROLEUM IN GASPE DISTRICT.

The Eastern section of the Gaspé district, which is embraced in the county of Gaspé, is occupied by what is geologically termed the Gaspé series (Gaspé sandstones and limestones), the sandstones corresponding to the Devonian formation and the limestones to the Upper Silurian. The existence of petroleum in this region, especially in the neighborhood of the anticlinals where the limestones come to the surface, has long been recognized.

We propose to indicate the best known points at which petroleum appears and which we have nearly all visited.

(1) Geological Survey of Canada 1863-1866.

At Sandy Beach, on lot B of York, two wells were sunk about twenty years ago, one of which yielded some twenty barrels of oil. The spot can still be seen covered with a blackish oil and little oily streams, and at Sandy Beach, as well as at Haldimand, the oil oozes from the mud and shingle of the beach. About a mile from Douglastown, on the right bank of the river St. John, a well was unsuccessfully sunk to a depth of 125 feet on surface indications which are no longer visible. Petroleum has also been noted at the second forks of the river St. John.

At Tar Point, at the entrance of the Bay, petroleum has also been found in a dyke of eruptive trap, which seems to traverse the region in an East to West direction, and, together with other similar eruptive masses, to have given rise to the anticlinal lines already noted. It has also been found at Seal Cove, at the entrance of the Bay.

On the left bank of the York river, one mile from Gaspé, important indications have been noted, as well as near the following creeks: Silver Brook, Little Forks, Grand Forks and Keg for a distance of 25 miles from Gaspé. At Silver Brook, two wells sunk to depths respectively of 800 and 900 feet yielded small quantities of gas and very little oil. Near the Little Forks, we have ourselves seen in two places the petroleum oozing out abundantly and impregnating the soil. Several bucketsful might have been easily collected from holes on the surface. We also remarked limestone outcrops, in the vicinity. These indications occur near the works of the "International Oil Co,"

The existence of petroleum in Gaspé was mentioned as far back as 1844 in the report of the Geological Survey of Canada for that year. About thirty years since, companies were organized and made some borings in the environs of Gaspé Basin. The most important of these associations, the "Gaspé Oil Co.", purchased from the Government a large tract of land in the townships of Baillargeon, Blanchet, Galt and Larocque, amounting in all to about 30,000 acres and comprising blocks 20½, 34, 38, 40, 42 and 44, on which borings were made to depths of 700 and 800 feet, on the left bank of the York river, near Silver Brook, but without result.

At Sandy Beach, on the right hand side of Gaspé Basin, a well of 700 feet, sunk on lot B of York, yielded about 20 barrels of oil. Apart from this, we are without information in regard to the works undertaken at that time, but it is very probable that they were abandoned owing to the inadequacy of the results. At all events there was no more talk of petroleum down to 1886, when a St. Paul (Minnesota) company, styled "The International Oil Co," purchased from the Government the section A B of block 41, forming 400 acres, in the township of Galt. In 1888, this company made preparations to work, built a road to 17

miles from Gaspé along the left bank of the York river, brought in a small plant, and sunk a well, but did not then prosecute the boring beyond 90 feet. In the fall of 1889, a better plant was pnt in and the company made another boring to a depth of 450 feet, but without result, and the works were then suspended for the winter. At the same time, an English company, the "Petroleum Oil Trust" represented by Mr. J. Foley, sank two deep wells in the neighborhood of the old well at Sandy Beach. This company took over the lands of the old "Gaspé Oil Co." and put in plant to make further borings. It is equipped with a most complete plant and provided with an experienced staff. It is consequently in a good position to succeed.

The section overlaid by the Gaspé sandstones extends around Gaspé Basin and especially over the valleys of the York, St. John and Dartmouth rivers. It also stretches into the interior of the peninsula, covering a vast tract of unexplored country and extending even to the line of the Intercolonial Railway towards the river Casupscul. The thickness of these sandstones is supposed to be considerable, which would, in certain cases, necessitate very deep borings to strike the limestone. Experts who have visited these regions have found certain analogies between them and the oil regions of the United States, but they are new, comparatively unexplored, and only a few borings have been made to test them. It is therefore to be hoped that future work will succeed in determining the rich workable parts, which certainly exist, in the district.

COAL.

As the carboniferous formation is represented only by a very small strip on the South-Eastern coast of the Gaspé district, it is not at all likely that coal will be found in the province of Quebec. At several points and notably on the Island of Orleans, and at Levis, St. Apollinaire and Ste. Sophie, small veins, three to four inches thick at the most, of a shining black, brittle, coal-like substance, burning without flame, have been met with. These small deposits occur in shining black shales readily decomposing on exposure to the air. Many years ago some workings were undertaken in the connection at Levis and St. Apollinaire. At the latter place, a pit was excavated to a depth of 20 feet and some barrels of the supposed coal were, it is said, taken out and used in a blacksmith's forge. But, the formations in which such substances are found are entirely different and much older than the coal measures and it is moreover the opinion of the highest geological authorities, that the idea of the possibility of finding real coal in the province must be abandoned.

PEAT. (1)

Peat abounds in the valley of the St. Lawrence, where large tracts in the shape of bogs are found covered with it; but thus far it has received no real attention and we are not aware of any deposit being regularly worked at the present time.

About 1864, peat was worked at Bulstrode (Arthabaska) (2) and it seems that good results were obtained by forming it into a sort of pulp and cutting it into bricks which were then left to dry and harden naturally in the air. It is said that the peat thus made was employed as a fuel for generating steam on locomotives and in iron puddling and that from it also was manufactured a charcoal for the use of blast furnaces. It was also proposed to mix it with magnetic iron sand in the form of bricks for treatment in the blast furnace. Within late years, a company has also made experiments with compressed peat, which seem to have given satisfaction, but we have no recent information on the subject.

However, on account of the great abundance of wood fuel in the country, peat, as already stated, has thus far commanded little attention; but there can be no doubt that industrial development will lead in time to its utilization both for industrial and domestic purposes and that it is in all probability destined to play an important role in the future, especially in the absence of coal in the province and in view of the fact that these peat deposits are generally of excellent quality. Peat bogs are met with, covering surfaces of 15 to 20 miles square and attaining sometimes a depth of 15, 25 and even 30 feet. In many places, the farmers partially drain the shallower beds of peat, set fire to them in summer, and then plough them up, an operation which is said to be attended with very good agricultural results. The most extensive peat bogs occur in the seigniories of Lavaltrie and Lanoraie, (Joliette), where they cover tracts of 12 to 15 miles square, with an average thickness of 10 feet. In the valley of the river Lacolle, there is another bog covering 15 to 20 miles of surface to a considerable but not yet accurately measured depth, the peat from which is very dense, leaves little ash and appears to be of superior quality.

In the seigniory of Ste. Marie de Monnoir, Rouville, and in the vicinity of Rimouski and on the southern coast of Anticosti, peat also abounds. At the

(1) Geology of Canada, 1863. (2) Geological Survey of Canada, 1866.

latter place, there is, among others, one bog, which extends for a distance of 80 miles, with a breadth of 2 miles and a depth of 3 to 10 feet, the peat being of good quality.

The following list indicates the principal localities where peat has been noted:

Argenteuil	Grenville I 1, VII 4.
	Harrington I 4, 5. V 1, 2.
Assomption	Seigniory of L'Assomption.
	Seigniory of St. Sulpice.
Champlain	Fief St. Etienne (near St. Maurice river).
	Seigniory of Champlain.
Huntingdon	Hemmingford.
Joliette	Seigniory of Lavaltrie.
	Seigniory of Lanoraie.
Kamouraska	Seigniory of River Ouelle.
Napierville	Sherrington.
Portneuf	Fief d'Auteuil.
Rimouski	Duquesne.
	Macpés.
	Matane.
	McNider.
	Madawaska road.
Rouville	Seigniory of Ste. Marie de Monnoir.
Saguenay	Anticosti.
St. John's	Seigniory of de Levy.
	Seigniory of Longueuil.
	Seigniory of Lacolle.
Temiscouata	Seigniory of Green Island, I and II concessions.
Terrebonne	Seigniory of Mille Isles (rang double).
	Ste. Anne des Plaines.

GRAPHITE. [1]

Graphite, or, as it is commonly called, plumbago, is found in two distinct forms in the rocks of the Laurentian series:

1o In the compact form, in veins or seams of from a few inches to two or three feet in thickness.

2o In the disseminated state, in the gneiss and calcites, in the proportion of from 10 to 50 %, these deposits affecting the stratified form and varying from a few feet to 20 and 25 feet in thickness.

COMPACT GRAPHITE.

This variety is relatively rare and only a few veins of it have been met with, in the townships of Buckingham (Ottawa) and Grenville (Argenteuil).

The most important deposit is located in the N. W. corner of lot 21 of the VIIth range of Buckingham and carries some fifteen veins of from 2 to 3 inches thick on the surface. Openings were made in it to a depth of 60 feet and it is said that the veins were found to widen out occasionally to 2 feet; about 100 tons of graphite were taken from these workings.

The graphite in this mine is in every sense as fine as that of Ceylon and is met with in all the varieties, compact, foliated, schistous and fibrous. The extent of the deposit might, perhaps, not suffice for the requirements of a company working on a large scale, but it might become an important adjunct to a manufacturer, who could also grind up the debris. The ore usually occurs in veins of quartz and white-feldspar.

Some work has also been done for compact graphite on lots V, 27, VI, 27, 28 and VII, 22 of Buckingham, as well as in the gore of Grenville (Argenteuil).

(1) Geological Survey of Canada, 1866, 1873-1874, 1875-76, 1876-1877.

The following analyses are taken from the report of the Geological Survey of Canada:

Carbon.....	99.675	97.626	99.815	99.757
Ash.....	0.142	1.780	0.076	0.135
Volatile matter.....	0.178	0.594	0.109	0.108
	100	100	100	100

The color of the ash varies from a light yellowish grey to a light reddish brown

For comparison, we also give the following analyses from the same source:

CEYLON GRAPHITE

Carbon.....	99.792	99.679	98.817	99.284
Ash.....	0.050	0.213	0.283	0.415
Volatile matter.....	0.158	0.108	0.900	0.301
	100	100	100	100

TICONDEROGA (N. Y.) GRAPHITE.

Carbon.....	96.751	97.422
Ash.....	2.153	1.760
Volatile matter.....	1.191	0.818
	100	100

In these two last cases, the color of the ash was the same as in the first and the degree of combustibility was also materially the same.

It will consequently be seen that the vein graphite of Canada is analogous to that of Ceylon.

DISSEMINATED GRAPHITE.

Graphite in the disseminated form occurs in the gneiss and in numerous white calcite veins of the Laurentian formation. It has also been found at the iron mine on lots 11 and 12 of the VIIth range of Hull township (Ottawa).

Sometimes, the amount of graphite met with in this form has been found so large as to induce working, but the attempts so far made in this direction have only served to demonstrate the great difficulty of separating the graphite from the carbonate of lime. Moreover, some of the richest deposits contain a heavy proportion of iron pyrite, which is also reckoned a noxious element or impurity in the different applications of plumbago.

The graphite disseminated in the gneiss appears therefore to be the only kind worthy of present attention, as it contains neither lime, nor iron pyrite, or, at all events, only a very slight proportion of the latter. Deposits of this class exist in great abundance and have been worked in the township of Buckhingham. These deposits are of variable thickness and occur in beds or layers of 2 to 25 feet, following the stratification of the Laurentian gneiss and also carrying a variable percentage of the mineral—the graphite being sometimes widely disseminated and not forming more than 10% of the vein and at others isolated, giving rise to masses which are nearly pure and which raise the average percentage of the vein to as much as 70%.

The following analyses are taken from the Geological Survey of Canada:

Graphite	27.518	22.385	23.798	30.516
Soluble matter in hydrochloric acid	17.539	19.467	21.285	2.475
Insoluble	54.899	56.408	53.741	66.874
Hygroscopic water	0.044	1.740	1.176	0.135

Assays made by other chemists have given 26. 20%, 15 to 30%, 10 to 50% and 25 to 40%.

Still, notwitstanding the abundance of these deposits, the graphite industry is one of the most difficult, because the product cannot find a market unless in the pure state, and because, to compete advantageously with that of Ceylon, it must combine certain conditions of fineness and purity which necessitate the employment of very complicated separating appliances, especially for the superior qualities. Moreover, the demand for plumbago is limited; certain brands are well known in the trade, and a company could not look for permanent working success except through the superiority of its products and the uninterrupted steadiness of its production.

The plumbago industry, which was started in the province of Quebec about 1867, owed its collapse to a fall in price provoked by other producers and to uncertainty and want of uniformity in the products put on the market at the time by the different Canadian companies, which had embarked in the enterprise.

A glance at the following table will show the difference in the prices and qualities of plumbago :—

A 0 was sold at from	.....	$1.75 to	$0.25	per lb.
A 1	"	30 "	12½	"
A 2	"	30 "	10	"
A 3	"	30 "	6	"
A 4	"	30 "	6	"
A 5	"	20 "	5	"
A 6	"	20 "	5	"
B 1	"	20 "	2½	"
B 2	"	20 "	2½	"
B 3	"	20 "	2½	"
F F	"	5 "	2	"

The A figures represent the superior grades, which differ from each other according to the uses to which the fineness of their grain adapts them.

A 0 is the extra quality in point of fineness and purity, but its use is very limited. The B grades are inferior in purity and differ from each other in fineness of grain. F F (foundry facing is the refuse, which is the most abundant, but, on the other hand the demand for it is small. It is employed by iron founders for dusting their moulds.

The following are the chief applications of graphite :

Electrotypy (A 0) Pencils, (A 0, A 1, A 2) Pianos, (A 1, A 2) Lubricant, (A 1, A 2, A 3, A 4, A 5, A 6) Crucibles, (A 3, A 4, A 5, A 6) Black lead for stove polish (B 1, B 2, B 3) Foundry facings, (F F.)

In 1878, the consumption for these different purposes in the United States was as follows :

Electrotypy	3 tons.
Lubricant	30 "
Pencils	50 "
Paints	100 "
Crucibles	4,800 "
Black lead for stove polish	3,000 "
	8,033 "

Since then there has been a considerable increase in the consumption ; but we are not in possession of the latest figures..

It will be remarked that about 60% of the production, including nearly the whole of the A grade, is absorbed by the manufacture of crucibles.

All the foregoing figures have been supplied by the "Dominion of Canada Plumbago Co.," the only one at present working and to which further reference will be made.

About 1860, in the township of Grenville, and about 1866, in the townships of Lochaber and Buckingham, graphite working was begun by the "Lochaber Plumbago Co.," which erected a mill and worked lots VIII, 24, XI, 23 and 24 in Lochaber. The "Canada Plumbago Co.," which afterwards became the "Montreal Plumbago Co.," also worked what was known as the "Castle" property, consisting of lots VI, 28, and V, 23½ of Buckingham, and built a mill in 1867, which was burned in 1873, after working down to 1872.

The "Buckingham Mining Co." operated on lots VIII, ½ S 21, 22 of Buckingham.

The "Dominion of Canada Plnmbago Co." worked lots VIII, 20¼ S, 21½ S and VII, 21½ N.

Several other companies and a few private parties also worked in Buckingham on the following lots: V 19½ S (Ste. Marie Mine) V, 24½ S (St. Louis Mine.)

Considerable quantities of ore were extracted from these workings, and a certain amount was shipped for assays and practical tests. But, for the reasons already specified, all these mines have been shut down since 1875, with the single exception of those of the "Dominion of Canada Plumbago Co." The most important deposits of the mineral seem to lie in the Western part of the VI, VII and VIIIth ranges of Buckingham.

The disseminated graphite is treated in the following way:—First broken into lumps and then crushed by ordinary stamps, the fine matter, mixed with water, then passes into round buddles or tubs, where the separation is effected by circular brushes which keep the mass rotating, the heavier materials being carried to the outer circumference by their specific gravity, while the lighter graphite remains in the centre. The latter is then removed, dressed, and dried in an oven, the finer grades being obtained by grinding and running through a centrifugal air separator. The refuse is either prepared by a second washing or set apart for use as F F grade or for stove polish.

THE WALKER PLUMBAGO MINES.

These mines were formerly the property of the "Dominion of Canada Plumbago Co.," which bought them in 1875 from Mr. W. H. Walker, of Ottawa,

who, in turn, repurchased them from the company in 1879. They embrace the following lots, in the township of Buckingham (Ottawa): VII, 19½ N, 21½ N, 23, 24; VIII, 19¾ S, 20½ S, 21½ S; IX, 19½ S. 21.

Prospects at numerous points have shown the existence of graphite in abundance on all the lots 19, 20 and 21 of the VIIIth range for disseminated graphite and 21 of the VIIth range for vein graphite.

This last mentioned class of ore, although the richest, is limited as to quantity, the amount produced thus far from the workings, which consist of shafts and openings on 15 distinct veins, only reaching about 100 tons. At present operations are suspended, but there remains at the mines a certain quantity of rich debris, which might be ground to advantage.

The most valuable portions of the property are those in which the disseminated graphite occurs. On lots 20 and 21 of the VIIIth range, there are several beds of 3 to 25 feet in thickness, which have been worked on a hill 100 to 200 feet high, at the foot of which an opening was made followed by a drift (20 x 25) running for 70 feet into the ore. At the surface of this opening a block, weighing 4,870 lbs, was cut out, which figured at the Philadelphia Exhibition in 1876. The same deposit extends to the N. E. on lot 19 of the VIIIth range and to the S. W. on lot 21 of the VIIth range. The quantity of mineral in sight is very large and, doubtless, practically inexhaustible, the casing rock being gneiss. The percentage of graphite, which it holds, is variable, but its average may be set down at 25%. The workable surface covers about 100 acres.

Concentrating works were erected, abandoned, and then started again in 1888. They are now working and seem to yield good results. They consist of a breaker, 2 crushers of 10 stamps each, 8 separating and dressing tubs (round-buddles), a dryer, and 3 runs of stones for grinding, besides blowers, mixers, bolts and accessories, worked by a 100 horse power steam engine, the whole with a capacity of 20 tons of ore per 24 hours. The theoretical grade of 25% corresponds to a practical yield of 15%, which would give 3 tons per day.

The previous company used to also manufacture black lead for stove polish and had further contracted with a Boston pencil manufacturing company to make lead pencils with its graphite, which bore the name of the "*Dominion of Canada Plumbago Co.*"

The company also owns a lumber mill, a barrel-making shop &c., as well as a small tramway of a few hundred feet in length leading from the mine to the concentrating works. During 1889, the latter were in operation for a part of the summer with a working staff of 25 men and turned out about 50 tons of first quality graphite, besides 400 tons of less finished products. The machinery, dwellings, &c., were also kept in good order,

In view of the increased demand for plumbago, Mr. Walker proposes to considerably enlarge his output and plant, which will furnish employment to upwards of 60 workmen. Moreover, the capacity of the crushers at present exceeds that of the dressing shop and a large amount of the unfinished product has in consequence accumulated.

The mine lies at a distance of 6 miles from Buckingham village, which is the terminus of a branch of the Canadian Pacific Railway, and it may be added that the exhibits from it won the highest prizes at the Ottawa Exhibition of 1875, the Philadelphia Exhibition of 1876, and the Paris Exhibition, of 1878, at which last, Mr. Walker was honored with the decoration of the Legion of Honor.

LIST OF LOCALITIES WHERE GRAPHITE HAS BEEN NOTED.

ARGENTEUIL....Grenville, IV, 13, 14, V 10, X 2.
Gore of Grenville II 3, VII 1, 3.
" Chatham IV 5.
Petite Nation Seigniory.
Wentworth III, 1, 2.

BERTHIER.....Brassard, C. 14, 16.

CHAMPLAIN...,..Radnor, II, (Pointe à la Mine).

CHARLEVOIX....Seigniory of La Côte de Beaupré (Bay St. Paul).

MASKINONGÉ...Lanaudière seigniory, Fontarabia concession (Ste. Ursule).

OTTAWA.....Buckingham, IV, 22, 24, 25.—V, 19½ S, 23½ N, 24, 26½ N, 27.—VI, 15½ N, 15½ S, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28.—VII, 4½ W, 20 (20½ N, (*Walker's Mines*) 21½ S, 22, 23, 24. 25, 26, 27, 28.—VIII (19¾ S, 20½ S, 21½ S, (*Walker's Mines*) IX 4½ W, 4½ E, 5.—X 3, 13, 17.—XI 4, 5.
Clyde II, 26.
Lochaber VIII, 23, 24, 25.—X 21, 22.—XI 23, 24, 25, 26½ E, 26½ W.—XII 23.

PONTIAC.....Waltham (Black river).

ST. MAURICE....Shawenegan IV, 13, 14.—V 13, 14.—VI 13, 14.

ASBESTOS [1]

This mineral, which miners also call cotton or rock cotton, has been only worked since 1878 in the province of Quebec. But the industry has already assumed so much development that the output, which only amounted at the outset to a few hundred tons, had risen to 4,000 tons in 1888 and to 6,000 in 1889.

The information in our possession shows that the province of Quebec is the country which supplies the largest quantity of asbestos to the trade. It is said that it has also been found in Italy, Corsica, Hungary, Sweden, Russia, South Africa and South America, but, whether due to difficulty of transport and extraction, scarcity of the mineral, or insufficiency of its quality, the outputs of those countries are comparatively null. A remarkable fact in the connection is that, while the production has increased with the demand, prices have also risen, so that, of late years, asbestos lands have been eagerly sought after. This is owing to the new uses which are being daily discovered for the article. Asbestos is chiefly used for packing the joints of steam and hot air pipes, &c., and as a covering for such pipes and for steam boilers. It is also used as a packing for breeches of cannon and to isolate electric wires. Felts or tissues to filter acids and to hold the residues from the manufacture of oils intended to be compressed are also made out of it, as well as packing paper, wall paper, felts, bricks, cements, paints. It is further employed as packing for fire-proof safes, to imitate grate fires with gas heating, to make gas burners, and to repair stoves and furnaces. Clothing for firemen, glass, iron and acid workers, curtains for theatres and ropes for escape ladders used at fires have also been manufactured from it, and, alone or in combination with other textile substances, asbestos is employed with felt, India rubber or steel.

In the case of joints liable to friction, asbestos is mixed with powdered soapstone, which imparts to it a lubricating action. It is also used in this state as packing for the pistons of steam engines. In fine, asbestos has a host of small

(1) Report of the Geological Survey of Canada, 1887-88 (R. W. Ells.) Report of the Commissioner of Crown Lands (P. Q.) 1886.

uses, such as glass makers' blocks, tobacco pipes &c., &c., which it would be too tedious to detail.

The *crude* asbestos must moreover be put through several operations before reaching these states, which do not all require the same quality. In the natural state the quality varies according to the length of the fibres and their degree of fineness.

CHRYSOTILE

Canadian asbestos belongs to the mineralogical variety named *chrysolite.* It is a silicate of hydrous magnesia, with a specific gravity of 2. 5., which exclusively occurs in serpentine, of which it is in reality a fibrous variety, with the following composition :

Hygroscopic water	12.20
Silica	40.42
Magnesia	33.21
Lime	traces.
Protoxide of iron	5.77
Protoxide of manganese	traces.
Alumina	6.69
Potash	traces.
Soda	0.68
Chlorine	0.22
Sulphuric acid	traces.
	90.99

In color it is white or green, with a silky, shining appearance. The fibres, taken separately, always look white. Veins of 0 to 3 inches have been found running in an almost normal direction with the walls of the encasing serpentine. The most ordinary and profitably worked size seems to be from three quarters of an inch to $2\frac{1}{2}$ inches. Indeed, veins have been met with in Broughton with threads of over 4 inches in length, but such specimens are rare.

Italian asbestos (1) is a variety of amphibole tremolite, showing the following composition :

(1) The two accompanying analyses have been taken from a prospectus of the " Bell Asbestos Co."

Hygroscopic water	14.20
Silica	40.25
Magnesia	40.18
Lime	traces.
Protoxide of iron	0.75
" manganese	traces.
Alumina	2.82
Potash	traces.
Soda	1.37
Chlorine	0.15
Sulphuric acid	0.31
	100.03

The fibre is occasionally several feet long and is imbedded longitudinally in the rock.

ASBESTOS OF THE EASTERN TOWNSHIPS.

Canadian asbestos is divided into three classes:

1st class.—Fibres long and bright.

2nd class.—Fibres not so long or so bright.

3rd class.—Fibrous material that cannot be ranked in the two foregoing classes.

Lastly, under the name of *waste*, is classed all the small refuse of the mines retaining some fibrous portions. This category is sold at a very low price, and employed for certain uses such as cement, bricks, &c.

Serpentine is met with in several parallel bands or belts in the Eastern Townships running in a general N. E. direction with the diorite and accompanying the Cambrian slates. It is frequently cut by large bodies of quartzose granites, which cover large surfaces in the mining districts.

All this serpentine is not productive and numerous varieties are met with, which contain little or no asbestos.

The true asbestos-bearing serpentine is of a deep bottle green color, very compact, and contains very little iron.

The principal belt of serpentine seems to begin in Bolton, to the south of the Vth and VIth ranges and again shows itself on the 13th lot of the VIIth range and on lots 8 and 9 of the VIIIth range, where a little asbestos has been noted. It then passes into Orford, where it partly forms the mountains of that township. It is next seen to the east of Brompton lake in Broughton on IX, 26 worked by the "Brompton Lake Asbestos Mining Co." The belt then appears to pass to the northward and the serpentine is again found in Melbourne, ranges V and VI, and in Cleveland, ranges XIV and XV, in the neighborhood of the slate quarries. Some small veins of asbestos have been noted at this point. Paying serpentine next occurs in Shipton, III 6 (W. H. Jeffery's mine), as well as to the south of Tingwick XI, 21, (Laurier Mining Co.) It again outcrops in North Ham, towards lot 20 of the IIIrd range, then in South Ham, around Lake Nicolet, particularly on the large island and on the eastern bank, where good veins of asbestos have been found,

In Garthby, the serpentine is slaty and unproductive. In the eastern part of Wolfestown begins the really rich section, which has its north western limit on lots 21 of the IV, III and II ranges.

The band then contracts from lot 24 of the 1st range at the corner of Wolfestown, Coleraine and Ireland and enters the two latter townships, where it expands and forms the mountains of Ireland and Coleraine, in the vicinity of Black Lake and Lake Caribou. At the latter point, it assumes its greatest expansion, its breadth reaching five miles and some of its hills rising to a height of 500 to 900 feet over Black Lake. Here are located the mines of Coleraine and Black Lake along the line of the Q. C. R.

In this district, the serpentine belt is bounded to the south-east by Lake Caribou and has been traced to lots 17 of A and B ranges of Coleraine, on the Poudrier road; to the north west after passing Black Lake, its limit is pretty nearly the line of the Q. C. R. It follows that line, contracting all the time, to Thetford, where it is not more than a thousand feet thick on both sides of the railway, but contains the important mines of Thetford.

After passing the 26th lot, a little serpentine and asbestos are again found on lots 16 and 17 of the IVth range (J. Reed's mine), and also at the Broughton mines, on lot 14 in the VIIth range of Broughton, where the serpentine is no longer more than a few feet thick, but contains remarkably fine asbestos.

Another outcrop occurs in the neighborhood of Little Lake St. Francis in Coleraine over a breadth of 1½ to 2 miles and a distance of 4 miles, forming high hills of massive serpentine, but containing only small veins of asbestos. This outcrop ends at the Poudrier road towards lots 5 and 6 of B range, so

that after that the asbestos found in Thetford is quartzose and unproductive towards the middle of the VII, VIII, IX and Xth ranges. Serpentine, containing some small veins of asbestos, has also been noted in the neighborhood of Adstock mountain.

Serpentine holding a little asbestos is next seen on the river des Plantes in the seigniory of Rigaud-Vaudreuil, on lot 8 of the 1st range N E, and in the Vth range of Cranbourne in the vicinity of the river Etchemin.

From this point, there has been little prospecting done and hardly any serpentine is met with, except in Gaspé, at Mount Albert (at the head of the river Ste. Anne) and at Mount Serpentine on the Dartmouth river.

It will thus be seen that serpentine fills a great place in the Eastern Townships, but workable asbestos only occurs in a very small section. It is, however, very probable that other discoveries will be made.

ASBESTOS MINING COMPANIES.

The most important districts are those of Thetford, Black Lake and Coleraine and the following are the names of the companies working asbestos mines throughout the region :

BROUGHTON.

Scottish Canadian Asbestos Co. (Limited, Glasgow) Broughton VII, 14,

THETFORD.

"King Bros." (Hampden Mine).....	Thetford	V, 26.
do (Thetford Royal Mine).....	do	V, 28.
"Bell Asbestos Co." (Limited London),.....	do	V, 27½ N. F.
"Ward & Ross.".....	do	V, 27½ S. W.
"Johnson Asbestos Mining Co.".....	do	VI, 27,
"Thetford Asbestos Co." (A. H. Murphy).....	do	VI, 28.
"Lucke, Mitchell & Co." (Beaver Asbestos Co.)..	Coleraine	C. 31-32.

BLACK LAKE.

"Bell Asbestos Co.".....	Coleraine	B 27½ N.E. 28½ N.E.
"American Asbestos Co." (Limited, Liverpool), (L. Wertheim).....	do	B. 27½ S.W. 28½ S.W.
"Montreal Asbestos Co." (A. H. Murphy).....	do	B. 32.
"Scottish Canadian Asbestos Co." (Limited, Glasgow).....	do	N. E. of the Coleraine Mining Company's block.
"United Asbestos Co." (Limited, London formerly Fréchette & Douville).....	do	
"Anglo-Canadian Asbestos Co." (Limited, London), Irwin & Hopper.....	do	
"Laurier Mining Co.".....	do	

"Ste. Julie Mining Co."	do	Central part of the Colcraine Mining Company's block.
"Johnson & Loomis."	do	
"Black Lake Asbestos Mining Co."	do	
"Central Mining Co."	do	

COLERAINE.

"Lambly"	Coleraine	S. W. part of the Coleraine Mining Company's block.
"Megantic Mining Co."	do	
"King Bros"	Ireland	III 24, 25.
"Bell Asbestos Co." (Bellemina)	Wolfestown	II 23, 24.
"Whyte Asbestos Co."	Coleraine	VI, 7, XII, 9.
do	Garthby	Is. 6½ n 5 III, 16.

DANVILLE.

"W. H. Jeffery	Shipton	III 6.

BROMPTON LAKE.

"Brompton Lake Asbestos Mining Co."	Brompton Gore	IX 26.

The "Scottish Canadian Asbestos Co.," the "Montreal Asbestos Co.," "Johnston & Loomis," and White Asbestos Co." have suspended their works for various reasons, as also Messrs McDonald Bros of Sherbrooke, who had done some work on XII, 8, of Coleraine (Little Lake St. Francis.)

The "Lucke, Mitchell & Co.," Laurier Mining Co.," "Ste. Julie Mining Co.," "Black Lake Asbestos Co.," "Central Mining Co.," "Brompton Lake Mining Co." are new companies dating from 1889, which have only done prospecting work as yet.

Prospecting work had also been done in Thetford IV, 16, 17 and in Coleraine, A 27, 28 29 by Dr J. Reed, in Ham III, 20 and in Tingwick XI, 21, by the Laurier Mining Co., in Bolton VIII, ½ W 8 and 9 by Heney Bros of Sherbrooke.

DEVELOPMENT.

The asbestos is very irregularly scattered through the serpentine and shows itself in the outcrops in the same way as in the solid rock; the workings are consequently simple quarries at the points where paying asbestos has been discovered at the surface. The leading companies use compressed air for drilling and derricks and steam for hoisting and pumping. It has been noted that steam drilling does not yield good results, as the water introduced into the holes to clean them ont only served to form plugs of asbestos which stopped the working of the drills.

The deepest quarries do not exceed 100 feet below the surface level. The large blocks of serpentine loosened by the blasts are broken by sledge hammers or smaller blasts and the pieces containing the asbestos are then removed to the cobbing shop, where boys break them up with small hammers and assort the asbestos according to quality. The refuse of all these operations is run through a sifter and forms the waste. This work is necessarily tedious and expensive and calls for strict supervision. Some companies give out their cobbing by the job, paying for it at the rate of $3 to $6 per ton of 2000 lbs,, first class being paid a higher rate than the others.

In 1886, the "Scottish Canadian Asbestos Co." put up shops at Black Lake to separate the asbestos mechanically from the rock. These appliances worked well for the 2nd and 3rd classes, though insufficient for the 1st; but the failure of the company unfortunately broke off the tests. The shop was chiefly composed of an ordinary crusher, which discharges the broken rocks on an endless table from which the cobbers remove the barren serpentine as it passes. The remainder is then run between two rollers armed with rubber springs whence it is carried to trommels, which retain the longer fibres constituting the first and second classes, while the small stones and finer fibre pass through. The short fibre forming the third class is then separated from the stones by a blower.

The "Anglo-Conadian Asbestos Co." uses a crusher and the broken product is then run through a sifter, which seems to give good results.

The mining is usually done by day work; but, in some mines, it is let out to contract at the following prices: 1st class, $27; 2nd, $26; 3rd, $24 per ton of 2000 lbs. cobbed and placed in bags of 100 lbs., the company furnishing the bags.

We have made a number of calculations to determine the proportion of asbestos in the rock, together with the proportions of the different qualities.

The proportion of the asbestos is necessarily very variable, but we consider that one per cent represents the average of all thus far extracted and also the limit of profitable working, an average of 2 to 3 per cent being very advantageous and above 4 being exceptional.

As regards the proportion of the different qualities, it may be stated that it is very variable according to the districts; that of Thetford furnishing the largest quantity of first class.

These proportions vary moreover with the mines, according to the output of the moment, the care used in cobbing, &c., nearly every mine having its own special brand, which is well known in the market, The bulk of the asbestos is

shipped *via* the United States to England, Germany and Italy. The United States only use a limited quantity. A small quantity of inferior quality has been employed by the "Asbestos Mining and Manufacturing Co." of Quebec, now in liquidation. (1)

The prices of the different classes also vary according to the mines and the appearance and qualities of the waste they may still contain. They may, however be quoted within the following limits:

1st class formerly worth	$80	to	$130	before 1889, is now quoted at	$100	to	$200
2nd " " "	50	"	75	" " " "	65	"	100
3rd " " "	15	"	35	" " " "	30	"	65
Waste is worth from	10	"	15				

per ton of 2,000 lbs in bags placed on the cars. The price of $150 to $200 is for extra qualities and small lots. (2)

The dressed asbestos still contains a considerable proportion of stone, which may amount to 15 to 20% in the case of average qualities and to upwards in the case of the inferior.

The wages paid are about the same as those mentioned in other parts of this work.

GENERAL OUTPUT.

The general yield, according to our information, may be estimated as follows:

Before	1882	1,220 tons.
In	1882	810 "
"	1883	1,124 "
"	1884	1,504 "
"	1885	1,727 "
"	1886	2,605 "
"	1887	4,061 "
"	1888	4,533 "
"	1889	6,067 "
	Total	23,650

(1) This company's plant was sold out in March, 1889, but the factory will continue to run.

(2) Recently, some has been sold as high as $210 per ton.

This output was divided as follows by townships:

Thetford	14,632 tons.
Coleraine	5,808 "
Shipton	3,080 "
Broughton	100 "
Wolfestown	30 "
Total	23,650

The average selling price of asbestos is estimated to range between $60 and $70.

The tables of trade and navigation of Canada show that the following were the shipments of asbestos during the years 1888 and 1889 to the 30th June in each case. For the previous years, the asbestos is not indicated, being probably embraced under the head of "other articles." The title "other countries" includes, Belgium, France, Newfoundland.

QUALITY.	WHITHER SHIPPED.	1887-1888.		1888-1889.	
		Tons.	Value.	Tons.	Value.
1st.	England	182	$ 13,286	145	$ 13,780
	United States (1)	2.325	175,691	3,979	282,135
	Germany	34	2,975	.....	.....
	Other countries	14	1,100	104	8,421
	Total	2,555	$ 193,052	4,228	$ 304,336
2nd.	England	58	2 648	87	5.900
	United States	512	21,208	108	4,226
	Germany	51	2,710	42	1,050
	Other countries	.....	.....	½	16
	Total	691	$ 26,566	237½	11.192
3rd.	England	86	1,895	21	860
	United States	150	6,332	90	4,610
	Germany	16	500	70	2,800
	Other countries,	¼	10	2	80
	Total	252¼	$ 8,737	183	$ 8,358
	General total	3,428¼	$ 228,355	4,648½	$ 323,886

(1) The bulk of this shipment goes to the United States in transit for European countries.

THETFORD MINES.

The Quebec Central Railway runs through these mines, which are chiefly situated on a small hill 170 feet over the Thetford river and 80 above Thetford station. On this hill and its flanks, the serpentine is alike, generally white and mottled on the surface, green inside and fairly hard. A distinction, however, must be made between the lands situated on the hill itself and those at its base, the latter requiring the removal of a layer of surface soil from 2 to 10 feet deep and the almost immediate use of machinery for hoisting and pumping. The quality of the asbestos is the same in all the mines of this district. It is white, remarkably silky and pure and the fibres are from a few lines to 2½ and even 3 inches in length. We have even seen a white variety at the Johnson and Ward-Ross mines, which measured 4 to 5 inches, and a variety, partly chrysotile and partly hornblende, at King Bros' mine, on lot V 26, that measured 8 inches. A sample of the latter product was very much admired at the Sherbrooke Exhibition in 1889. But these last products are exceptional and only met with in small quantities.

KING BROS.

This firm has been working since 1881 on the N. E. side of the above mentioned hill and to the south of lot 26 of the Vth range. The workings take the form of two large open quarries in the serpentine to a depth of 70 to 80 feet and for a breadth of 200 feet in one case and 100 in the other.

Since their outset, about 2,700 tons of asbestos have been extracted, 65 men working constantly. The work is done by hand and the hoisting by horse derricks. This year, a small steam pump has been set up to pump one of the quarries. This mine bears the name of the Hampden mine. The firm is presently putting in compressed air drills.

In the course of September, 1889, a pretty considerable landslide somewhat retarded operations.

In 1888, the same firm began operations on lot 28 of the Vth range (Thetford Royal Mine) on the other side of the railway line, where the ground is lower and the soil has to be removed to lay the serpertine bare. In 1889, an excavation of 30 × 50 and 25 feet deep was made. Steam drills were at once set to work and steam was also used for hoisting and pumping, First class asbestos was struck, similar to that on the hill, and some 50 tons were taken out by 20 hands. Every thing therefore leads to the presumption that the success will be the same as on the other side. A cutting made near the Thetford river has proved that the serpentine does not extend beyond it.

Mine in Ireland.—The same firm owns a number of properties in the township of Ireland on the great serpentine belt, and asbestos has been noted at many points on them. On lots 24 and 25 of the IIIrd range some prospecting was done in 1888 and some work in 1889; two excavations were made on hills 500 feet over Black Lake, from which 50 tons of asbestos were extracted by 15 men during the summer. The indications are very good and warrant the hope of a promising future in store for this mine; the quality is that of Black Lake, 2nd class being the prevailing variety.

The mine is 5 miles distant from Coleraine station, and transport can only be effected in winter, but there is reason to hopo that a good railway will be built before long.

BELL ASBESTOS COMPANY, (LIMITED) LONDON.

Lot V½ N. E. 27, formerly worked by the "Asbestos Packing Co." of Boston was purchased about two years since, together with other properties, by the present company, which has its headquarters and factories in London. This property has justified the favorable reports made in regard to it. Opened in 1880, it has produced 6,800 tons of asbestos, the bulk of it first class. It is situated on the hill of Thetford and is presently worked by means of three great quarries to a depth of 80 feet below the summit. The mining is done by compressed air drills and the hoisting and pumping by steam machinery. It is estimated that the output of 1889 amounted to 1800 tons with a working force of 100 men, which is the highest figure yet reached by any company. This mine is regarded as the most important and valuable of the region in point of production.

The company works only on one side of the Q. C. R. line, but it owns on the same lot, on the other side, excellent indications which assure the future of the mine.

Mine on the "Poudrier Road."—Besides the Thetford mine, this company also works, at Black Lake, a mine located on the N. E. part of lots 27 and 28 of B range of Coleraine near the Poudrier road.

This mine was opened in 1884 and 15 to 20 men are kept at work in it on the same mountain as the "American Asbestos Co."

Very fine asbestos is found in it, of the same quality as that of Black Lake. The total output has been about 300 tons, of which 200 were for 1889. All the work is done by hand and only during the summer. The mine is 2 miles distant from Black Lake station.

Bellemina.—This company also owns the Bellemina mine on lots 23 and 24 of the IInd range of Wolfestown (Wolfe.) This mine was worked in 1882 and 1883. Two large excavations and numerous "prospects" were made, but only 30 tons of good quality asbestos, but rather short, were taken out. The mine has been since abandoned. It is located on a hill, 500 feet high, near the Wolfestown road and about 4 miles from Coleraine station.

WARD & ROSS.

This property, situated on lot V, ½, S. W. 27, is worked by passing underneath the line of the Quebec Central Railway. It leaves to the East a small corner of 2 to 3 acres in which an excavation 80 × 80, and 30 to 40 feet deep, has been made, which has yielded about 1,600 tons of asbestos, partly, of first quality. The work is done by hand and the hoisting by horse derricks. A steam pump was only added to the plant in 1888 for the pumping. On the other side of the line, where the ground is lower, an excavation was made in 1887, which was worked with success and produced a certain quantity of first class asbestos. The mine has been worked since 1880 and has produced about 350 tons of asbestos a year, with a working staff of 40 men.

JOHNSON ASBESTOS MINING CO.

This mine occupies the N. W. part of lot VI, 27, on the south side of the hill of Thetford. The asbestos has been worked by five excavations since 1878 and the total output has amounted to 4,670 tons, mostly of first class. Work is done by hand and steam drills and the hoisting and pumping by steam machinery. The mine yields from 800 to 900 tons a year, working with 100 men. Like the foregoing mines, it has constantly returned large profits to its proprietors. The same company own lots X 25, 26 of Ireland and B 25, 29, 30 and 31 of Coleraine, on which very good indications have been noted, but no work done.

THETFORD ASBESTOS COMPANY.

This mine, which was formerly the property of Mr. A. H. Murphy, is situated on the N. W. part of lot VI, 28, on low ground. It has only been opened within the last two years, but real operations were only begun in 1889. The company is working on an outcrop of serpentine, but, to develop the mine, as much as 10 feet of soil had first to be removed and pumps at once put in. Thus far, all the work has been done by hand, with 15 men, and a certain quantity of asbestos has been taken out. The serpentine is the same as on the hill and the asbestos is generally first class. In the fall of 1889, steam machinery was being put up.

"LUCKE, MITCHELL & CO."

Although situated in Coleraine (range C, lots 31, 32) this mine is classed in the Thetford district, the serpentine being the same and the asbestos first class. In 1880, the mine was opened on the north corner of lot 32 and ten tons of first class asbestos were extracted and shipped. At that time, the hill workings were regarded as the only profitable ones and the mine was abandoned in the summer of 1889, but the new proprietors made an important discovery on the same lot and quite close to the line of the Q. C. R. This working has turned out a complete success, a large number of 1 inch veins having been noted, a little rusted on the surface, but perfectly light underneath, a few weeks' work having produced 8 tons of asbestos, of which $1\frac{1}{2}$ only were first class, on account of having been taken from the surface. In addition, numerous outcrops of fine serpentine containing first class asbestos, were also observed on the same lot and on lot 32, where the rock seems to be very rich, showing veins of 2 inches; from the old excavation, several tons were also taken out. The working surface is therefore considerable, these two lots lying entirely in the richest part of the serpentine belt and their direction being perpendicular to the Thetford lots. A part of the property is low ground and requires the removal of the surface soil and pumping.

The result of these prospects was sufficiently encouraging to induce the owners to regularly open the mine and to form themselves into a company under the name of "The Beaver Asbestos Co." Steam machinery for hoisting, pumping and drilling is also being put up on lot 32.

BLACK LAKE MINES.

These mines are situated on large mountains of serpentine on the S. E. side of the line of the Quebec Central Railway between Black Lake and Lake Caribou; a part of them being on the lands of the Coleraine Mining Company (the old Glover & Fry block) which lie between Coleraine and Black Lake stations and embrace about 6,000 acres in the serpentine belt. The company has divided its property into lots of different dimensions, but generally of 60 acres, which it rents to working companies for 20 years at a royalty of $6 a ton with a minimum of $1,000 a year, this royalty moreover being extinguishable by purchase.

The hills, which are, all of serpentine, are from 600 to 900 feet over the level of Black Lake, which in turn is 160 feet below the level of the station. They are bare of trees and all vegetation. The general quality of the Black Lake asbestos is inferior to that of Thetford, the proportion of first class being much less and the prevailing grade being second class. The length of the fibres is about the same as that of Thetford.

ANGLO-CANADIAN ASBESTOS COMPANY. (Limited) London.

The property of this company is included in the lands of the "Coleraine Mining Company", but has been bought out. Their mine was the first opened at Black Lake by Mr. N. Noel, of Sherbrooke, in 1881. It was sold to Mr. Chas. Lionnais. in 1883, again the same year to Mr. L. A. Senecal, and lastly in 1886 to Messrs Irwin and Hopper, of Montreal, who formed the present company and enlarged its territory, which now covers 325 acres. The mine is worked by steam machinery and compressed air drills—the actual workings consisting of three excavations at the foot of the large mountain and two other excavations in the S. E. side of a small hill lower down, together with a vertical excavation to a depth of 80 feet between the two hills. It is at the bottom of this excavation that the finest product is found; and 3,000 tons have in all been taken out. The average yield is 600 tons a year, with a working force of 60 to 70 men, but the company has opened new works and will largely increase its output. Considering the extent and situation of its property, the company has great facilities for disposing of its dumps of debris without interfering for a long time with the future of the works. It has lately added a crusher to its plant to help the cobbing, the crushed products being afterwards run through a sifter. This innovation effects, a great saving, besides yielding a product of good quality.

UNITED ASBESTOS COMPANY. (Limited). London.

This mine adjoins the "Anglo-Canadian Company's" property and is only of small extent, but it has the reputation of having so far produced one of the best qualities of asbestos at Black Lake. It has a frontage of only 372 feet at the foot of the mountain and has been opened along this front by two large excavations in the flank of the hill, from which 1,152 tons were taken out from 1885 to the 15th August, 1889. The mine was worked by hand down to October, 1889, as the property of Messrs. Fréchette & Douville, yielding 260 to 330 tons a year, with 30 men working. The present company, which purchased it in October, 1889, together with the rights of the Coleraine Mining Company, put in steam machinery and compressed air drills which are actually working and which warrant the prospect of a greatly increased output.

SCOTTISH CANADIAN ASBESTOS COMPANY.

This mine is also on the lands of the Coleraine Mining Company, but has also been bought out. Opened in 1884 by Mr. Chas. Lionnais, it became, in 1886, the property of the present company, which is now in liquidation and has done no work since 1888. This state of things, which is owing to special circumstances,

is much to be regretted, as the mine is as good as any of the others at Black Lake. It was worked by means of two large excavations at the foot of the mountain with steam machinery and compressed air drills. When operations were shut down, the number of hands employed was 80. Twelve hundred tons of asbestos had been taken out, four hundred of which were during the last year. The company had further established a mechanical separating shop, composed of crushers, endless cobbing tables, rollers, trommels, blowers, &c. The asbestos rock was conveyed to these works by a small tramway, and the work of separation, usually so tedious and expensive, was greatly simplified as the apparatus could turn out 20 tons of asbestos per day. They worked well, but were not found to be advantageous for the production of the superior or long fibre classes. Nevertleless, we regard these improvements as a great step in advance and I have no doubt that they can be employed to advantage for the production of the 2nd and 3rd classes from the waste which is so abundant at the mines and which cannot be profitably hand-worked. This company is the only one that has made this experiment and it is very desirable to see it resume work.

The company also made a few openings in the western part of the property, adjoining the Ireland line. This part is low and covered with soil; but the "prospects" led to the discovery of fine asbestos, besides proving that the rich belt of asbestos-bearing serpentine continues in that direction. This mine, as well as the two others, is a quarter of a mile distant from Black Lake station.

Fraser mine at Broughton.—The company also owns an asbestos mine on lot VII, 14, of Broughton, Beauce. This mine is particularly remarkable from the fact that the serpentine belt in it is very narrow, its breadth being only 15 feet and in contact with the talc schists, which sometimes turn into regular soapstone. The asbestos is contained, so to say, in a single vein of 8 to 10 inches, generally walled in, but yielding fibre of over 4 inches. In spots, the vein divides into a multitude of small veins of a few lines only. We traced the course of this serpentine belt for a distance of 900 feet, in an east-west direction and extending over the lot VI, 14. The mine was opened in 1881 by Dr. J. Reed, afterwards worked by an American company, and in 1886 became the property of the present company, which built a branch railway of $\frac{1}{4}$ mile to connect with the Quebec Central Railway and did some important work, including the sinking of three inclined shafts of 60 to 75 feet. A total of 100 tons of first quality was taken out and there remains on the ground a quantity of waste, which might be utilized for 3rd quality. The working of this mine is naturally expensive, as it has to be conducted altogether differently from the quarry workings of the other mines. It is necessary to make regular underground works, which must also be timbered and kept pumped out. The mine has been abandoned since the company has gone into liquidation, The asbestos procured from this mine may be considered as of the highest quality, both as to beauty and length of fibre.

AMERICAN ASBESTOS COMPANY, (Limited) Liverpool.

This property, which formerly belonged to Dr. J. Reed, comprises the S. W. half of lots 27 and 28 of range B of Coleraine. It became, in November, 1888, the property of Mr. L. Wertheim, manufacturer, of Franckfort-on-Maine, who formed the present company of which he is the President and principal stockholder. Before passing into the hands of this company, only a few openings had been made on the summit of the mountain, from which 55 tons of the mineral were procured. In addition, 60 tons were taken out to April, 1889. In the spring of 1889, the new company erected buildings, put in machinery, built roads and erected a village of some 20 houses for its workmen. It uses steam and compressed air, and, with 60 to 70 men, took out and shipped 400 tons to the close of the season of 1889, partly to Mr. Wertheim's own factories. The output for 1889 amounted in all to 528 tons. In addition, the company ran a tunnel 6 × 6 and 160 feet long, at the foot of the mountain and 100 feet below the level of the actual workings, in order to facilitate the work of extraction. This tunnel is interesting from the fact that,except in the case of the Broughton mine,which cannot be otherwise developed, it affords the only instance of underground works for asbestos mining. This style of work should in certain cases render good service and obviate too large quantities of waste, especially, when rocks, altogether barren or poor in asbestos, have to be cut through. The mountain on which the mine is located is 800 feet higher than Black Lake and 250 feet over the level of the adjacent lands, which presents great facilities for dumping. It will be further noted that, on ranges A B C, the lots run N E in the same direction as the band of serpentine.

During last winter (1889-90) from December to March, 250 tons were taken out, which presages a large output for 1890, especially when the preparatory work done and the excellent indications recognized are taken into account. The practical results obtained by this company must be regarded as remarkable for the first year and we suppose that the financial result has been quite as satisfactory.

The "Montreal Asbestos Co's" mine on lot B 32, Black Lake, should also be mentioned. This mine was worked during fonr months in 1888 and turned out 50 tons of good asbestos. The "Loomis & Johnston" in the centre of the Coleraine Mining Company's block and in which some small excavations were made about the same time, along the line of the Quebec Central, yielding a few tons of asbestos. also deserves to be noticed. These two mines are in a good location and the work already done should encourage new trials.

MINES OF COLERAINE.

MEGANTIC MINING CO.

This mine, the property of Messrs. Fenwick & Sclater, of Montreal, is situated in the S. W. part of the Coleraine Mining Company's block. This region was discovered in 1886, when the mine was worked by Mr. J. Kennedy, who, in the course of the same year, transferred his rights to the present company. The works consist of a single excavation on the hill 50 feet above the surrounding lands and 150 feet higher than the Coleraine station. The opening is 75 × 100 feet and 40 feet deep. The mine is worked by hand and has so far yielded 400 tons of asbestos. It is shut down in winter, but during the summer season an average of 7 men is employed, besides a blacksmith and boys for cobbing. The output has been about 100 tons a year. The property, which embraces 60 acres, is a mile and a quarter distant from Coleraine station.

W. H. LAMBLY.

This property, also situated in the Coleraine Mining Company's block, adjoins the foregoing mine to the North East and possesses a similar area. It was opened in the spring of 1889. At about ten acres from the "Megantic Mining Co's" excavation, numerous veins of very fine quality asbestos were discovered. Some work was done on them during the summer and about 25 tons were taken out by a few hands.

DANVILLE MINE.

W. H. JEFFERY.

This mine is the only one in the district and is situated on lot 6 of the IIIrd range of Shipton (Richmond) at a distance of 4 miles from Danville station (G. T. R.) It is probable that serpentine occurs at many other points, but, if so, it is buried beneath the arable soil, which is generally in the possession of farmers, while in Coleraine the rock outcrops everywhere and the small

quantity of soil met with is little suited to cultivation. At the time of my last visit, the workings comprised three large excavations, the deepest of which was about 100 feet and is located on a plateau about 180 feet above the surrounding lands. The mine has been worked since 1880 and has yielded in all about 3,080 tons of asbestos. Its present annual output is about 325 tons, with an average staff of 35 workmen. It is altogether worked by hand labor, without the help of any machinery. The asbestos is of very good quality, although the fibres appear short. This mine has been regularly worked since the commencement and appears to have yielded good profits to its owner. It is not worked in winter time.

OTHER MINES.

The foregoing districts are the only ones regularly worked, but search has been made and work done at other points, especially by the following companies:

The " Brompton Lake Asbestos Mining Co." began work in the fall of 1889 on lot IX 26, of the Gore of Brompton (Richmond.)

The " Whyte Asbestos Co." worked without success on lot IX 9, of Coleraine near Little Lake St. Francis, as well as in Garthby (Wolfe) I S 5 and 6.

The " Laurier Mining Co." worked in the fall of 1889 on the Coleraine Mining Co's block to the S. W. of the " Anglo-Canadian Asbestos Co.," where the "prospects" seemed encouraging. This company has also done some search work on lot III, 20 of North Ham (Wolfe) and in Tingwick (Arthabaska) XI, 21.

The "Black Lake Asbestos Mining Co." to the S. W. of the Johnston & Loomis mine and the " Ste Julie Mining Co." to the N. E. of the same mine on the Coleraine Mining Co's block, at Black Lake, made some " prospects " in the fall of 1889.

A new mine known as the "Central Mine" was opened by Steel & Co. in the spring of 1890 on the same block, but on the other side of Black Lake.

Dr. J. Reed has opened lots 27, 28, 29 of range A of Coleraine, where some fine indications have been found; he is having them actually worked by contract and a certain quantity of asbestos has been already taken out. He has also mined an lots IV, 16, 17, and 18 of Thetford, situated in a straight line one mile from the Quebec Central, near " Robertson Station," where workable and good quality asbestos has been noted. He olso owns asbestos-bearing, but still unworked properties in South Ham, in the neighborhood of Lake Nicolet,

ASBESTOS IN THE LAURENTIAN ROCKS.

Serpentine occurs at several points of the Laurentian formation, especially in Grenville (Argenteuil), Templeton (Ottawa) and Calumet Island (Pontiac.) It presents a honey yellow color and often holds veins of a very white, fine and often translucid asbestos, which is remarkable, but unfortunately does not exist in workable quantities. The veins are also generally very short. We have, however, seen one that measured $1\frac{1}{2}$ inch. An attempt to work the mineral was made on lot 10 of the VIII range of Templeton, but without satisfactory results.

ASBESTOS IN GASPÉ.

Serpentine is found in the county of Gaspé, at Mount Serpentine, on the Dartmouth river and at Mount Albert at the head of the river Ste Anne des Monts. In the course of an exploration made in 1889, we discovered on Mount Serpentine, in the vicinity of Ladies' Steps brook small veins of asbestos running up to $\frac{1}{4}$ of an inch in green serpentine.

At Mount Albert, the explorers of the Geological Survey note the probability of the presence of asbestos in the serpentine, which, at that place, covers not less than 10 square miles.

LIST OF ASBESTOS LOTS.

ARTHABASKA—Tingwick.—XI, 21.

BEAUCE—Adstock—V, 44.
Broughton—VI, 14. VII, 14.
Cranbourne—V, 37, 38.
Seigniory Rigaud Vaudreuil—I. N. E. 7, 8.

BROME—Bolton—IV, $4\frac{1}{2}$ W. VIII, 8, 9.

MEGANTIC—Coleraine—Coleraine Mining Block A. B. Range A, 19, **20**, **21**, **22**, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32. Range B, **4**, **5**, **6**, **17**, **18**, **19**, **20**, **21**, **22**, **23**, 24, 25, 26, ($27\frac{1}{2}$ N. E., $28\frac{1}{2}$ N. E. Bell Asbestos Co.,) ($27\frac{1}{2}$ S. W. $28\frac{1}{2}$ S. W. American Asbestos Co.,) 29, 30, 31, 32. Range C. 19, 20, 21, 22, 23, 24, 25, 26, **27**, **28**, 29, 30, (31, 32, Lucke, Mitchell & Co.) II. **25**, **26**. III, **25**, **26**, **27**, **28**, IV, **25**, **29**, **27**. VI, 7. VIII, 8, 9. X, $19\frac{1}{2}$, N. W., **$19\frac{1}{2}$** N. E. XII, 8, 9. XIII, 4, 5, 6.7, 8, **9**.

Ireland—II, 24, 25. III, (24, 25. King Bros.,) IV, 26, 27. V, 28. VI, 28. IX, 26. X, 25, 26.

Thetford—IV, 13, 16, 17, 18, V, 26. King Bros., 27½, N. E., Bell Asbestos Co., 27½ S. W., Ward-Ross, 28. King Bros, VI, 26, (27. Johnson Asbestos Mining Co.,) 28. Thetford Asbestos Mining Co.

Ottawa—Templeton—VIII, 10, 11.

Richmond—Brompton—IX, 26. Brompton Lake Asbestos Mining Co.
Cleveland—XIV, 7, 8, 9. XV, 6.
Shipton III, 6, Jeffery Mine.

Wolfe—Ham North—III, 20
Ham South—I. 17, 25.
Garthby—I, 5, 6. III, 16.
Island of Lake Nicolet.
Wolfestown—I **24**, II 22½ S. E. of ½ S. W., 23, Bellemina, 24. III **23**, 24, **26**, IV, **24**, 25, 26.

SOAPSTONE.

This mineral is a variety of compact talc and is also called *steatite*. In color, it varies from white to green and is remarkable for its softness and unctuosity. Reduced to powder, it is used as a lubricator and as paint. Slate and tailors' pencils are also made from it. It is very easily cut and, by subsequent calcining, hardened, when it can be converted into small objects of marquetry.

Soapstone of good quality is abundantly scattered throughout the magnesian rocks of the Eastern Townships and is itself a silicate of magnesia, but there is actually only one deposit of the mineral, worked by the "Wolfestown Mining Co.," the price being low and the demand limited. Crude soapstone, delivered on the railway, is worth $6.50 per ton, and $8.50 at Montreal. Ground, it is worth $16 per ton in lots of 5 tons and upwards.

WOLFESTOWN MINING CO.

The mine owned by this company is located on lot II 20 of Wolfestown (Wolfe). A quarry was opened a few years ago, from which 120 tons were extracted in 1888 and 150 tons in 1889 by 5 or 6 men. Work is done by hand and on a small scale. The mine is 6 to 8 miles distant from Coleraine station (Q. C. R.) A portion of the output is pulverized at Montreal by the "Cyclone Pulverizing Co."

More or less extensive beds of the mineral have been noted at the following points:

BEAUCE.....Broughton VII, 14.
BROME.....Bolton II ½ W 6, **26**, IV½ W 4, VI 24.
Potton ½ E 20, VI **26**.
Sutton VII 10, 12.
MEGANTIC.....Thetford III 12.
STANSTEAD....Hatley V 19, 20, 21.

WOLFE.....Garthby I S 6.
South Ham I 22, 24, 25.
Wolfestown I 20 (Wolfestown Mining Co.)

POTSTONE.—Compact chlorate or potstone, which can be used for similar purposes, has also been found in the same region. This mineral has not been worked, but a considerable deposit of it exists on lot II, 26 of Bolton. It has also been found on lot 12 of the IV range of Broughton.

PHOSPHATE OF LIME.

Apatite was first observed in Canada by Lieutenant Ingall on the Lièvre in 1829, only to be regarded at the time, however, as a mineralogical curiosity. It was not till about 1840 that its economic value as an agricultural fertilizer began to command attention in Europe, but since then phosphate deposits have been constantly searched for and discovered in all parts of the world. In Canada, it began to be worked about 1875 in the provinces of Quebec and Ontario, but the real development of the industry only dates from 1878, when it was marked by an output of 4,000 tons, which has since gone on increasing from year to year until an annual average of 25,000 tons has been reached during late years.

In the different countries, in which phosphate workings are carried on, the following varieties are recognized : (1)

Soluble guanos and leached guanos,

Nodules or sands, frequently mixed with fossils, separating easily from their gangue and closely enough conglomerated to form rocks.

Phosphorites in the form of compact or crystalline rocks.

GUANO is found on certain islands in the Pacific off the coasts of Peru and Bolivia. It is principally composed of the excrements of birds and contains, in the assimilable state, nitrogen, phosphate, potash and sodium in the following average proportions :

Nitrogen	10.90 %
Phosphate	27.60 %
Potassium and sodium	2 to 3

This is the soluble or nitrogenous variety which forms only in very dry climates such as the coast of Peru, where it occurs in thicknesses of more than one hundred feet mixed with the bones of sea fowl and marine animals. Analogous

(1) Bulletin No 46 of the United States Geologieal Survey, by R. A. F. Penrose, jr.

deposits, but of less importance, have also been discovered and worked on certain islands on the southern coast of Africa, near the Cape of Good Hope, on the coast of Arabia and in Australia.

Another variety of guano is that which has been subjected to the action of leaching by the rains or by sea water. It is partly mineralized and contains scarcely any more soluble elements. It is met with on the islands in the Pacific lying to the north-east of Australia, on the coast of Chili, and on certain of the West India islands such as Sombrero, Navassa, Curacoa, &c. It contains 70 to 85 per cent of phosphate, with little or no nitrogen and alkalies. The Mingan islands, in the Gulf of Saint Lawrence, have been thought to contain deposits having an analogy to guano and a similar origin, but the rainy weather of the Gulf seems little fitted for the preservation of such deposits and it is therefore probable that the soluble matter is quickly carried off by the water and the solid residue becomes mixed with the soil.

Nodules are rolled or rounded stones, the inside of which is frequently formed of fossils and which present the appearance of coprolites (fossil exuviæ) or of shells; occasionally, they also present a radiated appearance, their dimensions varying from the size of a grain of sand to that of masses weighing a ton and upwards. Generally speaking, these nodules are found imbedded in a soft clay or marl or in the solid rock. In the former case, a sufficient percentage is secured by extraction and washing; in the latter, utilization is hardly possible, unless the whole mass is of suitable grade (over 40 per cent). We may mention, as examples of easily separated nodules, those of South Carolina, of France, &c., while those of Russia are imbedded in the solid rock and are worked to less advantage on account of their generally low grade. Sometimes, the phosphate occurs in the form of sand as at la Somme (France), and in the district of Mons (Belgium), and these deposits are in general easy and advantageous to work. Phosphate in nodules or sand is also found in England, in the north and east of France, in Belgium, (Mons), in Russia, and in North and South Carolina, Alabama and Florida.

The deposits of nodules are usually encountered at little distance from the surface and are worked by quarries or trenches or by dredging the rivers as in South Carolina. The nodules are generally of low grade, but, on account of their abundance and the facility with which they are wrought, which renders them cheap, they are greatly sought after and all the more so because for agricultural purposes they can be applied directly to the land, when ground. An idea of their importance can be gathered from the fact that South Carolina annually produces a million of tons, of which it exports one half, that France produces 200,000 tons a year, Belgium 100,000 to 150,000, England 50,000, &c.

PHOSPHORITE is a variety of massive rock phosphate, sometimes attaining a high grade and at others mixed with the encasing rocks. Several varieties of phosphorite are recognized according to the countries in which they occur and its crystalline state frequently brings it very near to apatite, but we shall follow the practice of applying the name of phosphorites to the regular deposits of rock phosphate met with in the uncrystallized formations. Phosphorites occur in regular veins as in Spain or in irregular deposits as in the south of France. Their grade is in general high and is only lowered by admixture with the encasing rocks, and they are always treated for conversion into superphosphates. They are found in Spain (Logrosan and Cacères), in the south of France (Quercy, Lot, Bordeaux phosphates), and in Nassau (Prussia).

APATITE is the variety of phosphate in the pure crystallized state, to which the name of fluophosphate is also given on account of the presence of a strong proportion of fluor. It carries the highest grade, its percentage occasionally rising to 93. It always occurs in the eruptive or crystallized formations and in the crystallized or crystalline state only. Apatite has been found in Norway, Spain (Malpartida and Zarza), Portugal, and lastly, in Canada, in the provinces of Ontario and Quebec. We propose to give information in regard to our own deposits and the table appended will permit a comparison to be made with the principal foreign phosphates and show that our phosphates carry the highest merchantable grade. As it may be said, too, that the quantity is inexhaustible, it will be readily seen what a splendid future is in store for this industry.

SCORIÆ OF DEPHOSPHORATION.—As a source of phosphoric acid, we may also mention the scoriæ or slag resulting from dephosphoration of iron, of which large quantities, estimated at 50,000 tons a year for France, 100,000 tons for England, and 250,000 tons for Germany, are beginning to be employed.

TABLE SHOWING THE PERCENTAGES OF THE PRINCIPAL FOREIGN PHOSPHATES

	Nature of the Phosphate.	Formation.	Sample.	Percentage
England, North Wales	Nodules.	Cambro-Silurian.	Average.	46
do	do	do	Selected Nodule.	64
Cambridge, Bedford, Suffolk	Coprolites.	Cretaceous.	Average Nodule.	56
France, Ardennes et Meuse	do	do	Average.	35 to 40
Côte d'Or et Centre	Nodules	Jurassic.	do	60
Somme et Pas-de-Calais	Sands.	Cretaceous.	do	70 to 75
Bordeaux, Lot (Quercy), &c	Phosphorite.	Jurassic limestone.	Maximum.	84.35
do	do	do	Average.	70 to 78
Belgium, Mons	Phosphatic lime.	Cretaceous.	Crude.	15 to 25
do	do	do	Merchantable.	40 to 50
do	Sand.	do	do	60 to 65
Prussia, Nassau	Phosphorite.	Devonian.	do	65 to 75
Russia, Smolensk	Agglomerated Nodules	Cretaceous.	Average.	42
Norway, Arendal	Apatite.	Gneiss and Granite.	Maximum.	92.189
do	do	do	Merchantable.	76 to 85
Spain, Malpartidaand Zaza	do	do	Maximum.	92.06
do	do	do	Merchantable.	70 to 82
Logrosan, Cacères	Phosphorite	Silurian.	Maximum.	85
do	do	do	Merchantable.	50 to 80
do	do	do	Average.	65
United States, South Carolina	Nodules and Fossils.	Tertiary.	do	55 to 61
Florida	do	do	do	40 to 70
West Indies	Leached guano.	Present.	do	69 to 88
Pacific Ocean	do	do	do	72 to 88
Bolivia, Pacific coast	Guano.	do	do	27.60
Peru, do	do	do	do	27.60
Canada, County of Ottawa, P. Q., and Ontario	Apatite.	Laurentian.	Maximum.	89.810
do	do	do	Average.	80 to 87
do	do	do	Inferior.	70 to 75

CANADIAN APATITE (1)

This product occurs under the same conditions in the counties of Hastings, Addington, Frontenac and Lanark, in the province of Ontario, where its present output amounts to from 2,000 to 3,000 tons a year; but we propose to only deal here with the apatite found in the province of Quebec, where it exists in the crystallized or crystalline state in the gneiss of the Laurentian formation. It is always associated with other rocks, such as hornblende, feldspar, calcite, pyroxenite, &c., in very irregular deposits and hence the uncertainty which attends their working. It may be said to form part of the above mentioned bands of rock, which are met with in greater or less thicknesses. These bands traverse the Laurentian gneiss and have sometimes a breadth of several miles as in Templeton, Portland West, Bowman, and, in other instances, only of a few feet as in Buckingham and Portland East. It is consequently easy to understand that, in the former case, they take the form of pockets, while, in the latter, if the phosphate be abundant, it may predominate in these bands and assume the appearance of regular veins. Several hypotheses have been indulged in as to the origin of the Canadian apatites and the other phosphate deposits; but it seems to be now generally admitted that these deposits have had a chemical and not an organic origin, notwithstanding the many organisms met with in certain categories of them. We incline to this rational view, and, as far as our apatites are concerned, we maintain that their deposits were primitively regular beds analogous to those already mentioned and which have undergone a re-crystallization that has at the same time produced the color by which they are actually distinguished.

The color of the Canadian apatite is red or green, varying from very deep to very light green, the intermediate hue being the prevalent one. The color is evidently not due to foreign matter, as the same high grades are found in all the colors. The specific gravity is that theoritical of apatite, that is to say, in the neighborhood of 3.2 and the mineral is frequently encountered in the form of hexagonal crystals terminating in a point, some of which attain remarkable dimensions. In the Geological Museum at Ottawa, a perfect crystal from the Emerald mine can be seen measuring $62\frac{1}{2}$ inches in circumference and weighing 550 lbs., which also figured at the London Colonial Exhibition, and there also exists *in situ* at the Ætna mine (Anglo Continental Guano Co.) an enormous crystal, which is estimated to weigh several tons and which is 7 feet long by 4 wide. The most abundant and best formed crystals are usually found imbedded in white and rose-colored calcite. The variety in the form of sand, called "sugar phosphate," is also met with.

(1) Reports of the Ottawa Geological Survey 1873-74, 1876-77, 1877-78, 1880-81-82, 1882-83-84.

ANALYSES.—We append the analyses of Canadian apatites by Dr. C. Hoffman, of the Geological Survey of Canada: (Report of 1877-78).

Phosphoric acid	40.373	41.080	39.406	41.139	40.868	40.518	40.812
Fluorine	3.311	3.474	3.791	3.863	3.731	3.377	3.554
Chlorine	0.438	0.260	0.476	0.229	0.428	0.086	0.040
Carbonic acid	0.026	0.370	0.096	0.223	0.105	0.855	0.518
Lime,	47.828	49.161	46.327	49.335	48.475	49.041	49.102
Calcium	3.732	3.803	4.258	4.195	4.168	3.603	3.763
Magnesia	0.151	0.158	0.548	0.180	0.158	0.205	0.620
Alumina	0.609	0.705	1.190	0.566	0.835	0.267	0.565
Sesqui-oxide of iron	0.151	0.125	1.200	0.094	0.905	0.083	0.125
Insoluble residue	3.890	0.370	3.400	3.060	1.150	1.600	0.630
	100.509	99.506	100.512	99.884	100.823	99.665	99.729
Tribasic phosphate of lime	88.138	89.682	85.241	89.810	89.219	88.455	89.098

These samples must be regarded as choice specimens, as the most usual commercial grade ranges about 80%. Still it is not rare to see cargoes rating at 85 and even to almost 87%. The following analyses were made in England on cargoes of several hundred tons:

Chemists, G. H. OGSTON.		CANNON and NEWTON.	
Moisture	0.10		0.10
Water	0.50		0.15
Phosphoric acid	37.60		36.65
Lime	51.52		50.96
Oxide of iron and alumina	1.50		1.40
Magnesia and not determined	5.18		4.09
Carbonic acid	0.60		1.50
Insoluble	3.00		5.15
	100.00		100.00
Equivalent to Tribasic phosphate of lime	82.10		80.01
Carbonate of lime	1.36		3.40

The following analysis was made in New York in the case of a cargo of 250 tons of ground phosphate:

Moisture	0.040
Insoluble (quartz, mica, &c.)	1.160
Chloride of calcium	0.222
Fluoride of calcium	11.193
Phosphate of alumina	0.899
Phosphate of iron	1.661
Phosphate of magnesia	traces.
Phosphate of lime	84.852
	100.027

The deposits, which are being worked at present, are those situated in the northern part of Buckingham, Templeton and Portland East and West. Very important deposits also exist in Hull, Wakefield, Bowman and Denholm. as well as in Derry, Lochaber, Bigelow, Villeneuve, McGill, Wells and Hincks (Ottawa). They have also been found in Kiamika, on the Lièvre, at 80 miles from Buckingham, and in the townships of Lichfield, Mansfield, Pontefract, Calumet Island and Waltham, (Pontiac); in the townships of Maisonneuve and Provost, (Berthier) at 100 milesnorth of the St. Lawrence, and in the township of Caxton, (St. Maurice). It may consequently be said that phosphate extends over a vast field and that many of the known deposits only await means of transportation to be developed.

The companies actually working are the following:

Anglo Continental Guano Co. (Limited, London).

Ottawa Phosphate Co. (Limited).

W. A. Allan.

Dominion Phosphate Co. (Limited, London).

Dominion Phosphate Co. (New-York).

Central Lake Mining Co.

Canadian Phosphate Co. (Limited, London).

Phosphate of Lime Co. (Limited, London).

R. Blackburn. (East Templeton District Phosphate Mining Syndicate, Limited.)

J. MacLaren (The MacLaren Phosphate Syndicate, Limited.)

In addition, good properties are held by the following among other companies not actually working:

Anglo-Canadian Phosphate Co. (Limited, London).

Société Française des Phosphates du Canada.

Ch. Lionnais & Co.

Jackson Rae Phosphate Co. (Limited, London).

Without counting a multitude of mines opened up by private parties and not regularly worked owing to lack of capital or means of transport.

In the case of the mines in operation transport is effected from the mine to the river du Lièvre by means of carts or tramways; on the river to the village of Buckingham by barges towed by steamboats; and from Buckingham by rail (Canadian Pacific) to Montreal, the port of shipment to Europe. A special branch of 4 miles in length connects the wharf at Buckingham with the C. P. R. The foregoing modes of transport apply to the valley of the Lièvre. In Templeton, transport is effected partly in winter by sleigh to the Ottawa river, and then in the following summer by barges to Montreal. A small quantity is also forwarded by rail from the station in East Templeton (C. P. R.) The transport question is of great importance, since the more distant mines from the railway or the rivers can only forward their outputs during the winter and then the mineral can only be shipped to England during the next summer. Thus, the phosphate extracted during the summer of 1887 is only brought to the wharf or the railway during the winter of 1887-88 to be shipped to England during the summer of 1888, equivalent to 8 months later, which occasions a loss of time and of interest on capital.

The facilities of extraction are necessarily subordinate to the value of the deposit; thus, on a rich vein. the miner may immediately erect steam machinery, build good roads, &c., whilst, in the case of other mines of an uncertain character, he cannot go beyond erecting temporary works and a small outfit. The cost of extraction may therefore vary between $4 and $12 a ton, the latter figure not leaving a sufficient margin for profit.

COST OF MINING AND TRANSPORT.

Extraction (profitable average)	$5.00 to	$8.00
Transport to the wharf over a distance of 1 to 5 miles by cart	0.25 to	1.25
Transport to the wharf over a distance of 1 to 2 miles by tramway	0.20	
Transport by river in barges over a distance varying from 10 to 25 miles	0.30 to	0.60
Cost of transhipment at Buckingham	0.10 to	0.10
Transport by railway from Buckingham to Montreal	1.25 to	1.25
Cost of transhipment at Montreal	0.25 to	0.25
Commission, insurance, &c	0.50 to	0.50
	$7.65 to	$11.95
For mines provided with tramways	$7.60 to	$10.90

In the winter time, the hauling from the mine to Buckingham village landing costs from $1.50 to $3.00 for distances of 10 to 30 miles, which increases the above figures to $8.60 and $13.10. These figures apply to the Lievre valley ; but in the case of the townships of Hull, Templeton and Wakefield, the last mentioned prices apply at all seasons.

Needless to say, too, that these figures do not include the general costs of management, interest on capital, etc. It is estimated that phosphate, yielding 80 p. c., is worth $17 to $18 a ton, delivered at Montreal. Freights were quoted during the summer of 1889 at :

From 5 to 7 shillings.....to Liverpool
" 8 to 14 " ....." London
" 12 " ....." Hamburg

In England, phosphate sells per unit and according to the market rate, and in 1889 the prices were :

1 shilling $\frac{1}{2}$ d. per unit.....for 80 p. c.
$11\frac{1}{2}$ d.....for 75 p. c.

With a rise of 1/5 of a penny per unit.

Ground phosphate of 60 p. c. grade is worth 12 cents per unit, without rise. The importance of the grade of the phosphate will be gathered from the following :

80 p. c. being worth (1 sh. $\frac{1}{2}$ d.) × 80 = £5

85 p. c. would be worth (1 sh. $\frac{1}{2}$ d. + 1/5 d.) × 80 = £5 14 9

The highest price paid for phosphate has never exceeded 1 s. 6 d.

A sufficiency of Canadian laborers, familiar with mining work, and of horses for teaming, is procurable in the region. In the case of the more distant mines, the companies working them are obliged to board and lodge their men. Some companies have erected houses, which they rent to their hands and their families, and find this system very advantageous, as it enables them to retain their employees near their mines.

The wages paid are as follows : (1)

(1) As, in the course of this work, we shall not have again occasion to note other prices of labor, they may be regarded as virtually the same in all parts of the province.

Per month.

Sundry workmen (including board) $15 to $25
Children " " 5 to 10
Board is estimated at $10 a month.

For day labor.

Laborers $0.60 to $0.80 (with board) or $0.90 to $1.15 (without board)
" 0.75 to 1.00 " " 1.25 to 1.40 " "
Foremen, machinists, $1.25 to $2.00 (with board) or $1.60 to $2.40 (without board)
Double team and teamster, $3.00 (without board).

PRODUCTION.

The following figures are taken from the tables of the trade and navigation of Canada; but, as each province is therein credited with the products shipped through its ports, there is some confusion as to their real source. However, in the case of phosphate, the bulk of the article comes from Quebec, except some 2000 to 3000 tons a year during recent years from Ontario, which would make a total for that province of not more than 10,000 to 15,000 tons, inclusive of the small quantities consumed in the country. We therefore subjoin the figures of the total shipments for the two provinces, as they approximately represent Quebec's output. The years indicated end on the 30th June, and under the head of "Other Countries" are included Newfoundland, France, Denmark and Spain.

Years.	England.		Germany.		Other countries.		U. States.		Totals.	
	Ton.	Val $.	Ton.	Val $.	Ton.	Val $.	Ton.	Val $.	Tons.	Value $
1877-78	2930	53771	....	.....	732	10254	39	887	3701	64612
1878-79	9385	177949	336	6050	188	3478	2018	28818	11927	216295
1879-80	6792	108390	....	.....	....	.....	1182	11492	7974	119882
1880-81	13199	210364	....	.....	....	.....	2402	29129	15701	239493
1881-82	13197	258391	1469	31300	435	9000	2800	28976	17181	327667
1882-83	12263	255816	1995	44500	....	.....	220	2400	14478	302716
1883-84	21328	451092	....	.....	111	1980	32	250	21471	453322
1884-85	16878	327508	1361	25800	....	.....	745	8980	18984	362288
1885-86	23718	407314	1724	17820	....	.....	532	6817	25974	431951
1886-87	20465	360313	1595	29613	10	300	733	6223	22803	396449
1887-88	18638	368602	2111	38880	....	.....	1100	13011	21849	397493
1888-89	19690	322269	522	9850	....	.....	2911	32463	23158	360664
					Gen	eral T	otal.	.....	195,201	3,872,832

This total may be approximately apportioned as follows by townships, allowing about 10,000 tons to the province of Ontario:

Portland.....	112,000 tons.
Templeton.....	30,000
Buckingham.....	30,000
Wakefield.....	10,000
Hull.....	2,500
Sundry	500
Or a total of.....	185,000

for the province of Quebec to the 30th June, 1889.

At present, the rock phosphate is shipped to England, and the ground product to the United States. It is exclusively employed for making the superphosphates used in agriculture, but only in small quantities in Canada. In Ontario, they are manufactured by the "Brockville Chemical and Superphosphate Co.", and, in Quebec, by G. H. Nichols & Co., at Capelton, near Sherbrooke, where 500 tons of the mineral were used for the purpose in 1889.

There are three phosphate mills at Buckingham station:

That of the Canadian Phosphate Co., which owns the Crown Hill and Star Hill mines, and which can turn out 6 to 7 tons a day; the "Du Lièvre Phosphate Mill, F. S. Shirley", which grinds phosphates for different companies, and has a capacity of 25 tons a day, and, lastly, Lomer, Rohr & Co's mill, lately erected, which can put through 50 tons a day.

Inferior grade phosphates in sand are generally ground. They are first dried and then crushed, ground and bolted. The waste is about 3% to 5%.

These mills take their motive power from the falls of the river du Lièvre. Mr R. Blacburn pulverizes his low grade phosphate at the mine.

The working companies use steam and compressed air for hoisting, pumping and drilling, and about 500 hands are employed in the industry, exclusive of the number engaged in teaming and accessory works. Wood, which is still plentiful in the region, supplies the fuel needed, and the mines require very little timbering or pumping. The sorting or cobbing is done at the mines by hand; but, at some mines, a grating is used to separate the larger lumps of the mineral from the smaller and the latter are then put into a rotary sifter, the resultant fine sand forming the 75 per cent grade, while the small pieces are washed and handpicked.

Low grade mineral of 60 to 65% is accidental and only met with in special cases.

The following may be taken as the type:

1st quality rock	80 to 87
1st quality sand	70 to 75
2nd quality "	60 to 65

The sand holds about 1½ p.c. of moisture in the summer and 4 p.c. in the spring.

PHOSPHATE OF LIME CO. (Limited, London)

The mine known as the "High Rock Mine" was discovered in 1878 and developed by various parties until 1881, when it passed into the hands of the present company, one of the principal directors of which is Mr W. Pickford, of London. The value of this mine has been tested by 34 open cuttings situated on a high mountain 700 feet above the river du Lièvre, and comprising the lots VII 5, 6, 7 and 8 and VIII, 1 and 2 of Portland West, forming in all a block of 600 acres. Five of these pits are now being worked. Another mine known as the Dugway Mine", consisting of 3 acres in the centre of lot 9 of the VIIIth range, was developed some six years ago by the company and since abandoned, but was to have been reopened this spring with the aid of machinery. The company employs 130 men at the mine, and uses compressed air drills and steam machinery for hoisting and pumping. The workings at High Rock are connected with the Lièvre river by a small tramway, three feet wide and two miles long, following the natural slope of the hill towards the river. Cars, capable of carrying three tons, run down this slope naturally and are drawn up hill again by horses. The transport service from the pits to the cobbing sheds is also done by horse tramways or stationary engines and by means of cables for heavy grades.

The development works of the mine consists of large open cuttings following the phosphate veins underground and the deepest pit reaches a depth of 200 feet. The main opening is shaft No. 11, which has been worked for several years with excellent results. The entrance to the workings is on the west side of the mountain, 160 feet below the level of the summit, and the phosphate vein has been followed for a distance of 300 feet and to a depth of 70 feet, the thickest bed so far reached being 30 feet. Masses of ore have also been left standing at intervals to serve as pillars. This working still shows up very well, and, at the time of my visit, in October, 1889, I was enabled to determine the thickness of certain deposits of solid ore attaining from 12 to 15 feet and of remarkable purity. 11,000 tons were extracted from this working during the years 1887 and 1888.

The grading of phosphate is effected through the usual processes of screening, washing, sifting and handpicking, thus giving the saleable qualities: 1o rock and sand; 2o sand.

In the connection, it may be mentioned that the company only board about half their men, the remainder living with their families in houses leased to them by the company. This system is attended with several good results, such as keeping the men near the workings. Some of the hands have also been employed at this mine since the company went into operation.

The average annual output is about 6000 tons of higher grade and from 1500 to 2000 tons of lower grade phosphate, and thus far the mine has yielded a total of about 56,000 tons of first quality phosphate, carrying a percentage of 75 to 85.

The company are this year putting in an extensive plant comprising a compressor for 12 drills, together with 4 boilers and accessories, the whole to be located on the bank of the river. The compressed air will be conveyed over a distance of 600 feet through a 5 inch pipe to the mine, which will be provided with 3 new hoists and 7 or 8 more drills, and the company will then give employment to 100 more men.

CANADIAN PHOSPHATE CO. (Limited, London).

From 1882 to 1888, these mines were worked by the "Union Phosphate Mining and Land Company," of New York, which developed more particularly the "Star Hill Mine" on lots 8 and 9 of the VIIIth and lot 7 of the IXth range of Portland West.

The present owners, having succeeded the former company, have acquired, in addition to the above, lots 3 and 4 of the VIIth range, which are being developed under the name of the "Crown Hill Mine." There is only a distance of two miles between the two mines.

Star Hill Mine.—The chief workings at this mine consist of 4 pits (Nos. 2, 3, 4, 6) which are now worked at depths varying between 30 and 175 feet. The old works consisted especially of two large quarries of 300 × 50 and 100 × 50, contiguous to each other and reaching depths of 150 to 175 feet. The phosphate occurs disseminated in large pockets in the rock and a considerable quantity of the mineral has been extracted. The other workings are at a certain distance apart from each other, and, in addition, fine indications are visible, especially on lot 8, but have not yet been developed.

Several of the above mentioned openings contain red phosphate, and, steam power is used for drilling, hoisting and pumping.

The Star Hill mine is connected with the Lievre river by a cart road three and a half miles long and the hauling is done by carts in summer and sleighs in winter; but the company hope before long to have a tramway in operation.

Crown Hill Mine.—This mine, which has only been opened up within a few years, has yielded well. The development work consists of three openings, (Nos. 11, 15, 18) showing good beds of apatite. The deepest shaft is 120 feet and all the workings are connected by inclined cable or horse tramways. A cable tramway, operated by machinery, leads to the company's wharf on the Lievre river, one mile distant, and 600 feet below the level of the mine on the mountain. Steam is used at the workings.

The "Canadian Phosphate Co." took over these mines on the 1st January, 1888, and their output to the 30th November of the same year amounted to 4036 tons, and, from the 1st December, 1888, to the 30th November, 1889, to 6560 tons, of which $\frac{1}{3}$ was of first, $\frac{1}{3}$ of second, and $\frac{1}{3}$ of third quality, with an average working force of 150 hands. This output they hope to increase this year. Since the beginning of the works, the total yield of these mines appears to have been approximately 33,000 tons. The company also own the lots VII, 3, 4; VIII, 3, 4, 7, 8, 9; IX, 5, 6, 7, 8, 9; X, 1, in Portland West.

The same company has at Buckingham station a phosphate mill run by the water power of the Lièvre.

DOMINION PHOSPHATE CO. (New-York)

This company owns the "North Star Mine", VIII, 19, Portland-East, and "Washington" or "Landsdowne Mine", XI, N. p. 19, Buckingham. The latter, which is near the Emerald mine, was worked for some time; but, as the result did not meet expectations, the company abandoned it in 1883 and concentrated all its operations at the "North Star Mine", which had been worked by it since 1882. The preliminary workings at the surface gave the best indications, and the company was accordingly induced to continue the excavations. An inclined shaft at an angle of 20° was sunk to a depth of 605 feet following the phosphate—which in some places showed in remarkable abundance. In 1885, at a depth of 200 feet, a powerful deposit, measuring 20 feet thick, by 60 feet long, was struck. Since then, this shaft has been abandoned and another has been sunk to a present depth of 250 feet at an angle of 45°, with a rich showing of massive

phosphate. The company are sinking a third shaft with a view to continuing the prosecution of the work under the same conditions.

This mine is the only one in which the workings are carried on at a great depth and with regularity, but it may be remarked that the bed itself has the advantage of possessing a certain amount of regularity. The mine, too, is well supplied with plant and provided with steam hoisting and pumping machinery and compressed air drills. It is situated on a hill 650 feet high and 4 miles distant from the river du Lièvre and employs 50 to 60 men, its annual output having reached about 7,000 to 8,000 tons. The total yield so far has been 25,000 tons. The ore is hauled summer and winter to the company's wharf on the Lièvre, but it is proposed to shortly lay down a tramway. It was at this mine that the first compressed air appliances were put in to use on the Lièvre.

OTTAWA PHOSPHATE MINING CO.

The "Emerald Mine", which is situated on lot 19 of the XIIth range of Buckingham, has been worked by this company since 1884. Previously to that time, it had been opened and worked by several parties, namely, by the old "Buckingham Mining Co.", then by Murray & Allan, by W. A. Allan, and lastly, by the actual company. It lies on a hill 360 feet high, and three or four hundred yards from the river, and is distant eight miles from Buckingham village. The workings consist of open cuttings at different levels, supported by the pillars that have been left standing and connected by galleries. Water collects in these great pits, and, to obviate pumping, a tunnel is being cut at the foot of the hill to drain them and to facilitate the extraction of the masses of the mineral down to that level. The deposit wears an appearance of regularity, which warrants a presumption of its richness. The veins are of great thickness, and we saw one, some years ago, showing a solid breast of 90 feet of phosphate. The mineral is pure, but sometimes contains a little iron pyrite. The country rock is cut by trap dykes, the largest of which, 30 to 35 feet thick and with a general east and west trend, traverses the entire region. The average annual output of the mine is 5,000 tons, with a working force of 50 men. Steam is not employed for any purpose and all the work is done by hand. The total production of the mine since it was started may be set down at 35,000 tons. During the last two years, owing to preparatory works, only 3,500 tons have been taken out, with a working force of 35 men.

This mine, which is a very remarkable one, is most advantageously located. The level of the tunnel is 250 feet below the summit of the hill and the mass of mineral to be developed down to it would appear to be about 150 feet. Altogether, the mine wears an excellent appearance and there is a good future before it, although the property is very limited, being only 200 acres in superficies.

W. A. ALLAN.

Mr. W. A. Allan may be regarded as the pioneer of the phosphate industry in the Ottawa district and its development in that region has been largely due to his exertions. He has been the owner of some of the most important mines, such as the Emerald and the North Star and the Villeneuve (mica), and also owns a certain number of undeveloped properties. The mine known as the "Little Rapids Mine," on lot 6 of the Ist range of Portland East, was put in working order by him and he also owns lots 5 and 7 of the same range, where numerous tests have shown the existence of phosphate in large quantities.

The "Little Rapids Mine," which was originally owned by the "Buckingham Mining Co." has been worked since 1883 by Mr. Allan, who has sunk several shafts, the greatest depth attained being 210 and 220 feet, and opened several cuttings, showing thicknesses of 5 to 6 feet of phosphate. The mine is situated on a mountain 400 feet high and 4600 feet distant from the wharf on the river du Lievre, with which it is connected by an inclined tramway, and the deposit actually worked seems to affect a more regular formation. As the works, however, are more of a preparatory and exploratory nature with a view to the future of the mine, only an average of 6 men has been employed and the output has been necessarily small. Nevertheless, a certain quantity of high grade phosphate, from 83% to 86% has been taken out and some thousands of tons more of the mineral are in sight, no part of the reserve ore having been touched. The mine is well equipped with steam pumping and hoisting apparatus and compressed air drills, and, being in excellent condition, is ready to turn out a large yield as soon as it is regularly worked.

Mr. Allan has also developed the Battle Lake mines in Templeton, and is now engaged in opening a new mine on lots 27 and 28 of the IVth range of Portland West where the indications are remarkably fine, a cutting 40 feet long by 15 deep showing along its whole length splendid exposures of red phosphate from 13 to 20 feet thick, which also appear at many other points.

CENTRAL LAKE MINING CO.

The property of this company embraces lots 7, 8, 9 and 10 of the Xth range of Portland West, but the most important workings are on lots 7 and 8. Some prospects were made a long time ago, but the regular development work by Mr. Franchot only dates back to the fall of 1887. The phosphate deposits occur in hills averaging 200 to 300 feet in height around Central Lake. The indications are plentiful and the most important are to the number of twenty, from

which 1,000 tons have been extracted, with 15 men. As these mines are situated however, on the level of the High Rapids of the Lièvre, hauling from them can only be done in winter; but they will become much more important on the completion of the dam and locks at Little Rapids, as the High Rapids will then be submerged and, the mines being only one mile from the river, transport can then be easily effected in summer.

DOMINION PHOSPHATE CO. (Limited, London).

This company began work in October, 1889, on lot 8½ N. of the Ist range of Portland East. The mine is situated on a hill, 200 feet high, at a distance of a quarter of a mile from the Lièvre, on the level of the Little Rapids. The surface indications show a vein of phosphate of from several inches to 2 and 3 feet thick, for a distance of 300 to 400 feet. The company immediately put in steam drills and is working with 30 men. It also owns lot 7 of the IInd range.

ANGLO-CONTINENTAL GUANO CO. (Limited, London).

Towards the end of 1889, this company acquired the lots 17½ N. and 18½ S. of the XIIth range of Buckingham. The S. ½ of the lot 18 was the lot originally owned by Sir J. A Grant, of Ottawa, on which important developments, including a pit some 70 feet deep, were made with good results. It is estimated that 3,000 tons have been raised out of this shaft. Phosphate outcrops occur at numerous points and under the same conditions as at the adjoining Emerald Mine. Lot 17 has been but lately explored, the prospects being very encouraging. The company is now at work and busy setting up machinery. The mines are known as the "Squaw Hill" and "Ætna Phosphate Mines."

TEMPLETON DISTRICT.

Mr. R. BLACKBURN.

Before 1888, the properties at present owned by Mr. R. Blackburn were in the name of R. Blackburn and J. MacLaren, They embrace a large number of lots in Templeton.

The principal mine worked is on lot 10 of the XIth range. It consists of one large excavation, 300 feet long, 200 feet wide and 130 feet deep which has been extended westwards by underground workings comprising three levels of drifts or galleries, of about 250 feet long and communicating with a shaft of 192 feet exactly at the western extremity of the great excavation. The company are now sinking in the eastern part a shaft, inclined at an angle of 60°, which will pass under the principal excavation and connect with the deep shaft, which it is intended to further deepen. These works will enable the company to continue the development of the mass, which was originally worked at the surface in the early days of the mine. The situation of the mine is on ground of no great height and steam has been employed for hoisting, pumping and drilling. This mine is the richest in the Templeton district and turns out 3,000 tons a year, working with 50 to 60 men. It has produced in all about 28,000 tons. The quality of the phosphate is remarkably pure, some shipments having graded nearly 87 per cent. On account of preparatory work in 1889, its output that year only amounted to 1,400 tons.

Since 1889, the mine has been equipped with a pulverizer for the inferior grades, which produces 4 tons a day, working with 3 men.

This mine is 11 miles from the Ottawa river and 14 miles from Templeton-East (C. P. R.), the hauling being done both in winter and summer by waggon at the rate of $1.50 per ton in winter and $2.50 in summer. The phosphate is forwarded chiefly by barge to Ottawa.

The mine was long worked by hand, and steam drills have only been in use since 1885. In 1889, some prospecting work was done on the adjoining lot 11, XI, the resnlt being some fine discoveries, and a recent opening has a good showing, from which a good deal of phosphate has been taken out.

These mines were lately sold to an English company, which is working them under the name of the East Templeton District Phosphate Mining Syndicate (Limited). The inclined shaft has been abandoned and work is proceeding in the western part. Besides lots 10 and 11, this company owns several other lots, including ½ N. 7, 8 and 9 of the same range.

J. MACLAREN.

Mr. MacLaren's properties were recently purchased by an English company, "The MacLaren Phosphate Mining Syndicate" (Limited), which immediately began operations with some 50 men, on lots XII, 8; XI 7½ S; 10½ N.; VII, ½ N. 4, 5, 6.

LOMER, ROHR & CO.

Messrs. Lomer, Rohr & Co., phosphate commission agents at Montreal, formed the "East Templeton District Phosphate Mining Syndicate" and the "MacLaren Phosphate Mining Syndicate" of which they have retained the control and management, as well as of the "Foxton Phosphate Mining Co." in Ontario. They also buy phosphate from different companies and have contracted to again work the Battle Lake mines and to re-dress old waste, especially at the Emerald Mine.

They have also established a very important mill at the Lièvre basin for concentrating and preparing the phosphate in the ground and granulated state. These works, which furnish employment to some 30 men, are capable of turning out over 50 tons a day. They comprise driers, rotary crushers, grinders, sorters, bolters, air separators, &c., and their motive power is derived from the falls of the river. Shipments are made directly by the cars of the C. P. R. railway. All the staffs of these different undertakings are under the direction of Messrs. Lomer, Rohr & Co., who have their head office at Montreal.

JACKSON RAE PHOSPHATE CO. (Limited, London).

Lot 9½ W of the Xth range of Templeton has long been the property of Mr. Rae, who formed a company in England last year. The old workings are very extensive and consist of two large openings in the southern part of the lot, from which several thousand tons of phosphate have been extracted. The works are presently suspended. Transport is effected either by way of Templeton or by the Ottawa river. The mine is 14 miles distant from Templeton.

CHAS. LIONAIS & CO.

In February, 1889, Mr. Lionais became largely interested in the "Canada Industrial Co.," (Limited) which owns 1300 acres of phosphate lands in Templeton, including lots IX 16 and X 9½ E, and took the management of the works on the last mentioned lot. Steam drills were put in and a good deal of work was done in sinking four large pits from which a certain quantity of phosphate was extracted; but the idea seems to have obtained that it was better to assure the future of the mine by preparatory works at the surface and the setting up of the necessary plant. In 1889, 260 tons of 1st class out of 320 taken out of the exploratory works were shipped and operations were suspended in the fall.

This mine is known under the name of the "Post Mine" and the company propose to so develop it as to secure a large output this year.

The foregoing companies are those, which were working in 1889, but it is well to also note some other companies which own good properties, but which have at present suspended operations for various reasons:

SOCIÉTÉ FRANÇAISE DES PHOSPHATES DU CANADA.

This company, which has its headquarters at Bordeaux (France), owns the following lots: Portland-East I 13, II 2½ W., 3½ N. III 1, 2, IV 1½ S. 2½ W. 3½ N. VI. 7. 8. 9. 10. 22. 24. 1 p. N., 3. VII 7. 8. 9. 10. 21. 27. 28. VIII. 6. 9. 10. 11. 12. 16, 17. 30., IX 4. 5. 9. 16. p. S., 17. 18. 19. 20. 30. 31. Portland-West, IV. 20, X. 3 Templeton, XIII 3, forming in all 4.795 acres.

Work was done on the lots in Portland-East III 1, 2, IV 1, VIII, 16, 17, but not more than 2,000 tons were extracted, chiefly from lot 2 of the IIIrd range. The company, which was organized in 1881, closed its works in 1883.

ANGLO-CANADIAN PHOSPHATE CO. (Limited, London).

This company, after having worked for some time on lot XIII, 6, of Templeton (Battle Lake Mine) where important development work was done, as well as on lot lot X 2 of Portland-West, transferred the seat of its operations over the province line to Olly lake and Bob's lake in Ontario. The following lots are owned by the company:—Portland-East, I, 4, II, 1½ W, V, 13, 14; Portland-West, X 2, 4, 5; Templeton, XIII 6, 7; Gore of Templeton, 9, 41, 42, 43, 44, 45, 46; Bowman, VII, 26, 27; Wakefield, II, 20½ E 21½, N 22. The company was started in 1886 and suspended operations in the province of Quebec in 1887. Considerable

development work had been done at Battle Lake, steam machinery being used for drilling and hoisting and the hauling being done in winter on the river du Lièvre. Previously to 1886, the company bore the name of the "Du Lièvre River Land and Phosphate Co."

GLASGOW CANADIAN PHOSPHATE CO. (LIMITED.)

This company owns the following lots: Portland-East IV 1½ N; 2½ E; Derry, II 1, Formed in in 1884, the company shut down its works in 1886

PHILADELPHIA AND CANADA PHOSPHATE CO.

Some work was done in 1883 on lot VIII, 27, Portland-East by this company, which has not since operated.

CHAPLEAU & CO.

During 1883, work was done on lots 15, 16, 17, 18 of VI Portland-East, but abandoned the following year. The firm also owns lots 5, 6 and 11 of VIII, Portland-West.

TEMPLETON AND BLANCHE RIVER COMPANY.

This Montreal company worked on lot XI, 6, of Templeton during 1886, but has since suspended operations.

MARK HALDANE.

Important development work, consisting in numerous openings from 5 to 80 feet deep, has been done, with good returns, on an important phosphate deposit in the best workable eondition on lot 12, I of Wakefield. Previously to 1887, 4,500 tons had been raised from this mine and shipped.

The deposit worked is valuable and is remarkable for its regularity. Transport is effected by teams for 15 miles to the river Ottawa and then by barges to Montreal.

GEMMILL & Co.

Considerable development work has been done by this firm on lot IV, 24½ S. of Wakefield, from which 4,000 tons, generally of red phosphate, have been taken. The deposit has been worked regularly by means of steam drills, &c., but the ownerc discontinued operations three years ago owing to the then low price of phosphate. The ore was shipped *via* Ironside on the Gatineau to the Ottawa river and by Templeton-East (C. P. R.) By the latter route, summer transport involves barging across Lake McGregor.

The same firm has also opened mines on lots IV 24½ N and V 22, 23, 24, of the same township, as well a the following lots in Hull township :

From lot XII, 10, about 1,000 tons of light green phosphate were taken out. This bed shows a remarkable peculiarity, the phosphate occurring in numerous veins distributed over the lot in a manner resembling that of certain deposits, in Ontario; 200 tons of phosphate were also taken out from lot 14 of the same range. On lots XIII, 12, 13, a shaft, 70 feet deep, was sunk and about 300 tons were taken out. The phosphate of this district is of a reddish green coler. It is shipped *via* Ironside, seven miles distant.

DU LIÈVRE PHOSPHATE MILLS (F. S. Shirley.)

This property was formerly known as the "Du Lièvre Milling and Manufacturing Co." and includes the "Lillie" and "Arnold" mines on lots II, 2, 3 of Derry. These mines, which were opened some years ago, show fine indications of phosphate, but have been shut down until further orders.

Mr. Shirley's mills at Seabury (Basin of the Lièvre) near Buckingham station, are run with a turbine deriving its motive power from the falls of the river du Lièvre and equipped with a rotary drier. The rock is thrown into the drier and thence carried automatically to the crusher and grinder, pass through a bolter of 80 meshes to the square inch and are then bagged, the waste being about 5 per cent, but for saving which arrangements are now being made.

The mills are capable of treating 25 tons per day and grind phosphate for different companies. A new method of treating the ground material has been tried by Mr. Shirley, and produces what he terms a semi-soluble phosphate, samples of which have been tested with the best results, it is said, on the Ottawa experimental farm. (1) The works are actually suspended.

(1) Experimental farm report 1889, page 52.

OTHER MINES. (1)

In addition to the foregoing, there is a large number of lots, which have been opened by their owners and which show the finest indications; among others the following:

WAKEFIELD.....III, 12½ N., 19, IX, 30. (Harris.)
HULL.....X, 15, (Scott's) XI 9½ N., (Davis) XII, 9, (Prud'homme) XIV, 10½ S., XVI, 12½ S., (Moore) 16. (Barber.)
TEMPLETON.....VII, 3½ S., 4½ S., 7, X. 7, (Grier) XII, 11½ S., (Miller) 12½ S., Gore 6, (Murphy.)
PORTLAND WEST....VI, 6, VII 1, 2, X, 6.
PORTLAND EAST.....I, 3½ W.
BOWMAN.....I, 44, II, 31, 32, III, 33, 34, V, 27, 28, (Brazeau) VI, A, 32, VII, 7, 8.
DENHOLM.....VIII, 6.
WELLS.....II, 13½ E, 14½ E, III, 14.

We append a list of all the lots, which to our knowledge contain phosphate. The numbers in large black letter type indicate the lots on which the mining rights still belong to the Crown. (2) These lots are in some cases occupied by farmers, who however only own the surface. The brackets designate the most important among the properties worked:

BERTHIER....Brassard—C. **16**.
Maisonneuve—IV, 11.
OTTAWA.....Bowman— I, **42**, **43**, **44**, **45**, **46**, **52**, **53**, **56**. II, **25**, **26**, **27**, **28**, 31, 32, **33**, **39**, **41**, **42**, **43**, **44**, **45**, **46**.—III, **17**, 18, **32**, 33, 34, **35**, **36**.—IV, lot A. 1, 2, 3, 4, 5, 6, **9**, **10**, **12**, **13**, **14**.—V, **4**, **6**, 8, 9, **10**, **11**, **12**, 15, 16, 17, 26, 27, 28, 29, **30**, 31.—VI, lot A, 5, 6, **13**, **14**, **15**, **30**, 31, 32.—VII, 6, 7, 8, **13**, **14**, **15**, 18, 19, 21, 22, **24**, **25**, 26, 27, **28**, **42**, **43**, **44**, **57**.
Buckingham—VII, 19, 21, IX, 17, 20, X, 25, 26½S, 27, 28.—XI, 18, 19, 20, 21, 22, 25½S, 26, 27, 28.—XII **17**½ S, (17½ N. 18½ S: Anglo-Continental Guano Co) (191 Emerald Mine, Ottawa Phosphate Co.) 26½ N. **26**½ S, 27, 28.

(1) A new company, "The General Phosphate Corporation" (Limited, London) has been recently formed, but has not yet started operations.

(2) The same indications apply to the other lists cited in this volume.

Bigelow—I, 1½ E, 7½ E, **7½** W, 8.—II, **33**.—III, **36**, **40**, **49**.—IV, **5**, **6**, **51**, **52**, **53**, **54**.—VI. **5**, **6**, **7**, **9**, **10**.

Denholm—I, **2**, **3**, **4**, **5**, **6**, **7**.—V, **8**.—VII, **4**.—VIII, **4**, 6, 8, 9, 10, 11, **12**, **13**, **14**, **15**, **16**, **17**, **21**, 22, **24**, 25, **26**, Rg. A, **23**, **24**, **28**, **29**, **30**, **35**, **36**, **40**, **41**.

Derry—I, **1**, 5, **9**, **10**.—II, 1, 2, 3, 4, 5, 9, **10**, **28**.—III, 1, 2.—IV, **1**, **2**, **5**.—V, **1**, **2**.—VI, **1**, **2**.

Hull—X, 4, 6, 7, 15.—XI, 4½ N, 5½ N, 9½ N.—XII, 6½ S, 9, 10. 14, XIII, 3½ S.—XIV, **10½** S,—XV, **16**.—XVI, 12½ S, 16, 17, 18, 19.

Hincks—XIV, **12**, **13**. (Phosphate has been noted at different points in this township, but the exact numbers of the lots are not known.)

Lochaber—VII, 25½ N.

McGill—IV, **1**, **2**.

Portland-East—I, 1½ W. **1½** E, 2, 3, 4, 5, (6. Little Rapids Mine) 7, (8½ N. Dominion Phosphate Co., London). 12, 13.—II, 1, 2, 3, **4**, **5**, 6, **7**, **8**.—III, 1, 2, 4½ W, **4½** E, 5, 6, **7**, **8**.—IV, 1, 2, 3.—V, **3**, **11**, **12**, 13, **14**.—VI, 1½ N, **1½** S, 2. 3, **5**, 7, 8, 9, 10, **11**, **12**, 14, 15, 16, 17, 18, **19**, **20**, **21**, 22, 24, **26**.—VII, **5**, **6**, 7, 8. 9, 10, **11**, **12**, 13, 14, 15, 17, (18: North Star Mine) 19, 20, 21. 22, 23, 24, 25, 26, **27**, **28**.—VIII, 3, 6, 9, 10, 11, 12, 13, 16, 17, 18, **19**, 20, 21, **24**, **25**, 26, 27, 28, **29**, 30.—IX, 4, 5, 9, 16, 17, 18, 19, 20. **21**, **22**, 27, 28, 30, 31.—X, 1, **2**, **3**, **4**, 27, 28.

Portland-West—I, **2**, **4**, **25**, **26**, **27**.—II, **10**, 19, 21, 22, **24**, **25**, **29**, **30**.—III, 5, **10**, 11, 12, **14**, **15**, **16**, 24, 25, 26, 27, 28.—IV, 20, 25, 26, (27, 28: W. A. Allan Mine), **32½** N, 32½ S.—V, **17**, 18, 19, **26**, **35**, **36**.—VI, **1**, **2**, **3**, **4**, 5, 6, 17, 18, **25**, **26**.—VII, 1, 2, (3. 4: Crown Hill Mine), (6, 7: High Rock Mine), 8, **19**, **20**. —VIII, **1½** E, 1½ W. **2**, **3**, **4**, 5, 6, 7, 8, (9: Star Hill Mine) 10, 11, 13, 14p., **14**r., **20**, **21**.—IX, 1, 2, 3, 4, 5, 6. (7: Star Hill Mine) 8, 9, 10, **15**, 17.—X. 1, 2, 3, 4. 5, 6, (7, 8, 9, 10: Central Lake Mine) **11**.

Templeton—VII, 3, 4, 7.—VIII, 6, 7. 8, 15, 17, 18.—IX, 5. 6, 9, 11, 13, 14, 16, 17, 18, 21, 26.—X, 5, 6. 7½ N, **7½** S, 8½ W, 8½ E, (**9½** E: Chas. Lionnais & Co.), (9½ W, Jackson Rae Phosphate Co.), 10, **11½** E, 13, 14, 15, 16, 17, 18½ N. 19, 23½ S, **23½** N, **24½** N, 25, 27.—XI. 3, 4, **5**, (6: Templeton & Blanche River Phosphate Co.). 8. 9, (10: R. Blackburn Mine) **12½** W, 12½ E. 13. 14, 15, **17**, 18½ S, **18½** N, **24**. **25½** N, 25½ S.—XII, 5, 6,

7. 8, 9½ S, **9½** N, **10**, 11, 12, 14½ N. E. **17½** N, 17½ S. 18, 19½ E. **20**, 21, 22½. N, **22½** S, **23½** N, **23½** S, **24**.—XIII, 3, 4, 5, (6, 7: Anglo Canadian Phosphate Co.), 8, **9**, 10, 11, 12, 13, **14**, **15**, **16**, 17, **18**, 19. **20**, **21½** W, 21½ E, 22, 23, 24, 25. 28.

Gore of Templeton—1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, **13**, **14**, **15**, **16**, **17**. **18**. **19**, 20, 21, 22, 23, 24. 25, 26, **27**, 28, 29, 30, 31, 32, 33, 34, 35, 36. 37, 38, 39. 40, 41, 42. 43, 44, 45, 46.

Villeneuve—I. **32**, **33**, **34**, **35**, 36.—II, **1**.—III, **5½** E, **5½** W.—IV, **1**, **2**.—VI, **1**, **2**, **6**.—VII, **1**.

Wells—I, **16**. **17**, **18**.—II, **11**, **12**, 13pE. 14pE.—III 14.

Wakefield—I, 7½S, **11**, (12 : Haldane's Mine). 13, 14½S. **14½**N. 16, 17, **23½**S, **24**.—II. **10**, **12**, 13½S, **13½**N, 14, 15, 16. 17½S, **17½**N, 18½S. 19, 20½E, **20½**W. **23**.—III, 12½N, **13½**N, 16, 18, **19**. 20½N, **22**, 24, 25, **29**, **30**.—IV. 3½S, 10½N, 22, 23, (24½S : Gemmill's Mine) 24½N, **25**, 26, 29, 30.—V, **10**, **20**, 21, **22½**E, 22½W, **23**, 24½S, **24½**N, **25½**N, **26**. **27½**S. 27½N, 28½N.—VI, 24. **25**, **26**.—VIII, **29**.—IX, **30**.

St. Maurice. . Caxton—Phosphate has also been noted in this township.

Pontiac. . . . . Calumet Island—VIII, 30, 31, **32**. **33**.

Litchfield—VI, 27.—VII. 26.

Mansfield—IV, 8, 9.—VI, **19**, 20, 21, 22, 23,

Pontefract—A, **14**, 15, 16, **17**. **18**.—IV, **1**, **2**, **3**, 4, 5. 6, **7**.

Waltham—B,15½W, 16½W. 17½ W.

As will be seen, the only deposits actually worked are those in the southern part of the county of Ottawa.

Improvement in the means of communication and transport will undoubtedly lead to the development also of the known deposits in the other townships as well as to fresh discoveries. For instance, it is reported that important beds have lately been discovered around lake Ste. Marie in the township of Hincks.

In the county of Pontiac, the presence of phosphate has been noted at several points, but no attempt to work it has yet been made. I nevertheless believe that this county has a fine future before it and that it offers a vast unexplored field to prospectors.

MICA.

Mica is very common in the Laurentian rocks and occasionally enters into their composition. Large quantities of it are sometimes met in the phosphate mines. Still the commercial quality, used in the arts, is relatively rare. It occurs in the Laurentian formation and forms the variety known as *muscovite.* This variety, colorless and transparent in thin sheets, assumes a greenish hue in the mass. The colors of the other varieties are black, brown or smoked. The muscovite variety is found in veins of white or transparent quartz associated with orthoclase feldspar, which also contain a great many rare crystallized minerals, such as black or other colored tourmaline, red garnet, common emerald, opalescent feldspar, and occasionally such ores of those rare metals, uranium and cerium, as monazite, samarskite &c., which are very curious from the mineralogical point of view.

The most abundant of these minerals is black tourmaline. The quartz, which is often transparent, constitutes the real rock crystal; and the feldspar is invariably white or but slightly colored.

To render them workable, such veins, containing only a small proportion of mica, must be very thick, at least 50 feet, under ordinary circumstances, taking into account the hardness of the rock to be worked and the variable dimensions of the mica, which is often bent or stained, thus causing considerable waste. Ground mica, which is employed in painting or as a lubricant, in the manufacture of wall papers, theatre decorations &c., and white feldspar, which enters into the composition of porcelain, may be regarded, however, as additional products of the mica mines. Mica in plates or sheets is chiefly employed for the fronts of stoves, but it has a multitude of other small uses, such as in ventilators, smoke-consuming apparatus, isolators in electricity, &c. As it is not liable to be broken by concussion, it is also employed instead of glass in the windows of ships of war and of buildings, in which explosions are frequent. It may be remarked, however, that very little mica is exported from Canada, but at the same time it is well to note that the United States produce a certain quantity of it. Prices greatly depend on the dimensions. The price list of the Villeneuve mine, for instance, shows that mica of 2 × 2 inches is quoted at $0.50 per lb., of 3 × 3 at $2.25; 4 × 4 at $9.10; 5 × 5 at $12; 6 × 5 at $12.75, and 7 × 5 at $14.50.

VILLENEUVE MINE.

This mine, situated on lots I, 30, 31 of Villeneuve township (Ottawa Co.), is the only mica mine developed in this province. The earliest development work dates back from the summer of 1884, having been started by Mr. W. A. Allan, the proprietor of the mine, who transferred it later on to the "British and Canadian Mica Mining Co," (limited). The mine is now owned by Mr. S. P. Franchot, and has been actively worked, from 1884 to 1888, and during that lapse of time has supplied the trade with an output of about 35,000 lbs. of merchantable mica, representing an annual yield of 9,000 lbs. Nearly all the mica was sold in Canada. The ore taken out of the mine is sent to Buckingham where it is cut according to desired sizes, packed up and shipped.

The development work of the mine consists of one opening made against the face of the mountain wherein the vein occurs, on the south part of the above mentioned lots. This opening is about 70 ft. long × 50 wide, and 60 ft. deep. An open cut has also been made on the mountain, which has an altitude of 150 ft. above the neighbouring grounds. The vein, 140 ft. thick, runs in a N. E. direction. Steam and compressed air have been used, with a staff of over twenty men. Operations were suspended towards the spring of 1888 and were resumed in the fall of 1889.

The mine is 3 miles distant from the Lièvre river with which it is connected by a good wagon road, the wharf being about 20 miles distant from Buckingham (C. P. R.), to which place the ore is transported by boats.

As usual, quartz, feldspar and tourmaline have also been found at this mine in pretty large quantities, as well as certain rare minerals, such as common emerald, red garnet and remarkable samples of cerite, monasite and uraninite (ores of uranium and cerium). (1)

We saw a piece of mica measuring 30 × 22 inches. There has also been taken out of this mine a crystal weighing 281 lbs., which yielded about $500 worth of merchantable mica.

The company has also shipped a certain quantity of waste which is to be converted into ground mica.

In this connection, it may also be mentioned that the feldspar of the Villeneuve mine has been recognized both in the United States and in England, as remarkably fit to be utilized in the manufacture of porcelain ware. It has been mixed with kaolin in a proportion of 52% and the tests have given the best

(1) Ottawa Geol. Survey, 1886.

results. In 1889, about 400 tons were shipped to England and to the United States, and although the price is not very high ($7 to $9 a ton), it may be considered as a very important adjunct of the mica mining industry.

The following analyses show the remarkable purity of the feldspar :

Silica.....	64.7	63.96	64.61
Alumina.....	18.4	19.16	18.49
Potash and soda..	not determined	16.88	16.90
Iron		traces.	
Magnesia.....	0.3		

The two first analyses were made on specimens of feldspar from the Villeneuve mine and the third analysis is the theoretical analysis of pure orthoclase feldspar.

The other mines discovered but not worked in the province are the following :

Wakefield (Ottawa) VII, 25½W. This lot shows a large vein of white quartz, with green feldspar and diversely colored tourmaline.

Maisonneuve, (Berthier) II, 1, 2. A large vein, similar to the preceding one, with emerald, garnet, samarskite (columbate of uranium, itrium and cerium) (1)

This mine is situated at 80 miles from St. Félix de Valois C. P. R. station. It was opened seven years since and good mica was taken out, but, no doubt, owing to the remoteness of the mine and the dificulty of access, work was suspended.

Watsheshoo, (Saguenay). At Watsheshoo Bay, on the north shore of the river St. Lawrence, some work was done during the summer of 1889 on a large vein holding good mica, associated with white and rose-colored quartz, white and green feldspar, tourmaline, garnet and emerald.

In 1889, some very fine specimens were brought from a mica mine discovered near Lake Manouan, to the north of the Peribonka and about 250 miles from Lake St. John.

LIST OF PLACES WHERE MICA HAS BEEN FOUND.

Berthier.....Maisonneuve—II, 1, 2.
Chicoutimi....Jonquières—North range 21, at Lake à la Mine (North of the River Peribonka.)

(1) Geological Survey of Canada, 1880-81-82.

Ottawa.....Buckingham IX, 20½S.—X 20½S.
Bouchette—I, 38; X 10; 11.
Low—XII, 36.
Wakefield—VII, 25½E.
Villeneuve—I, 30, 31 (S. P. Franchot.)
Pontiac.....Cawood—II, 21, W. p.—22½E.
Saguenay.....Watsheshoo Point. (North shore of Gulf of St. Lawrence.)
St. Maurice...At the Six Falls (Six Chutes) north of the River du Loup.

MOLYBDENITE.

MOLYBDENITE or sulphuret of molybdenum occurs at several points in the province. Its resemblance to plumbago leads occasionally to its being mistaken for that mineral, but from which it is distinguished by a characteristic difference. While plumbago is incombustible, molybdenite, in the fire, gives off the odor of burning sulphur and leaves a yellowish residue. It also leaves a greenish metallic streak on porcelain.

Molybdenite is used in chemistry and also for the manufacture of certain special pigments and dyes, but its consumption is very limited.

This mineral is generally met with in the foliated state in the quartz veins of the Laurentian formation. It has also been found in the Harvey Hill copper mines at Leeds. But the point where it seems to occur in most abundance is Quetachoo-Manicouagan, on the north shore of the Gulf of St. Lawrence, where it has been noted in workable quantities, though nothing has been done yet in a regular way to develop it.

It is met with in the following localities:

BERTHIER.....Provost.
MEGANTIC.....Leeds XV, 17.
PONTIAC.....Aldfield III, 1, 2.
Calumet Island, north range 13.
Waltham, (Black river.)
SAGUENAY....North shore (Quetachoo-Manicouagan.)

MINERAL WATERS.

Having given as yet no special study to the subject of the mineral waters of the province, we are indebted for the greater part of the following information to the Geology of Canada, 1863, (page 531 and following) from which we sum up a special chapter :

These waters are divided into six classes and abound chiefly in the sedimentary rocks; none of any note having been discovered in the Laurentian series

1st Class. Neutral waters containing chloryd of sodium, calcium and magnesium; they always contain iodids and bromids, sometimes with sulphates together with small quantities of carbonate of lime and magnesia, and are generally very bitter to the taste. They are found at Bay St. Paul (Charlevoix) (this water is sulphurous), Les Eboulements (Charlevoix), in the IIIrd concession of the seigniory of River Ouelle (Kamouraska), and at St. Benoit (Two Mountains).

2nd Class. This class includes a large number of saline waters, which differ from the first in containing, besides the chloryds of sodium, calcium and magnesium, considerable portions of bicarbonates of lime and magnesia. Small quantities of oxyd of iron and of baryta and strontia are also frequently present.

These waters are generally less bitter and more pleasant to the taste than those of the first class, as they contain much smaller proportions of earthy chloryds. They occur in the Point du Jour range (L'Assomption), (Aurora Spring) in the seigniory of Baie du Febvre, in the Grand Range (Yamaska), in the neighborhood of Berthier (Berthier), on the river Yamachiche, in Caxton (St. Maurice), at Champlain (Champlain), between Lanoraie and L'Industrie (Joliette), in the IInd concession of the seigniory of Ste. Anne de la Pocatière (Kamouraska), at St. Eustache (Two Mountains), at Ste. Geneviève, on the Batistiscan River (Champlain), and at St. Leon (Maskinongé).

3rd Class. The alkaline waters of this class contain, besides chlorid of sodium, a small portion of carbonate of soda, with bicarbonates of lime and magnesia. Small portions of baryta and strontia and of boracic and phosphoric acids are often present in these waters, and bromids and iodids are very rarely wanting. They are met with at the following places : Seigniory of Belœil (Verchères), seigniory of La Baie du Febvre (Yamaska), in the environs of Chambly

in the range des Quarantes (Chambly), in Rawdon III, 25 (Montcalm), at St. Hyacinthe (Providence Spring), at Ste. Martine (Chatauguay) (sulphurous water), and at Varennes (Verchères).

4th Class. Alkaline waters, containing less chloryd of sodium and more carbonate of soda than those of the 3rd class. They generally contain a much smaller amount of solid matters than the others and have no marked taste. They are found in the vicinity of Chambly, at the Grand Côteau (Chambly, on the Jacques Cartier River, at Marcotte's Well (Portneuf), this last being sulphurous; in the concession des Quarante (Nicolet), in the seigniory of the Baie du Febvre, in the city of Quebec (St. John's Suburb), in Rawdon III, 27, (Montcalm), in the IInd concession of the seigniory of Ste. Anne de la Pocatière (Kamouraska) and at St. Ours, on the Richelieu River (Richelieu).

5th Class. This class includes acid waters, containing a large proportion of free sulphuric acid, with sulphates of lime, magnesia, protoxyd of iron and alumina. They also contain some sulphuretted hydrogen and have an acid styptic taste. Springs of this class are rare and have not been noted in the province of Quebec, any more than those of the 6th class, which include certain neutral saline waters containing sulphates of lime, magnesia and the alkalies, together with chloryds in small quantities.

It has been remarked that certain of these springs, especially those of the 2nd and some of the 3rd class, also give forth combustible gas in abundance. Moreover, these springs seem to originate in the Trenton formations which occupy the valley of the St. Lawrence.

Several of them are utilized and a few are widely known and supply to consumption large quantities of mineral waters, more especially those of St. Leon, Providence and Varennes, &c.

The province of Ontario also possesses a number of analogous springs, which are turned to account. We have only indicated the springs noted in the Geology of Canada, 1863, but there is a number of others in different sections of the province, some of which furnish drinkable water.

We may note that the gas well at Maisonneuve, near Montreal, furnishes a very good sulphurous water.

Mineral waters are found in the following places:

ASSOMPTION.... Point du Jour (Aurora).
BERTHIER..... Berthier.
BROME..... Potton VI., 28.

Chambly	Chambly, Rang des Quarante.
Champlain	Champlain, Ste. Geneviève, Ste. Anne de la Perade.
Charlevoix	Bay St. Paul, Eboulements.
Chateauguay	Ste. Martine.
Gaspé	Gaspé Basin South, Dartmouth river.
Hochelaga	Maisonneuve.
Joliette	L'Industrie.
Kamouraska	Seigniory of River Ouelle, III concession. Ste. Anne de la Pocatière, II concession.
Levis	Lévis.
Maskinongé	St. Léon.
Montcalm	Rawdon III, 25, 27.
Richelieu	St. Ours.
St. Maurice	Caxton, Yamachiche.
Two Mountains	St. Eustache.
Verchères	Belœil seigniory, Varennes.
Yamaska	Baie du Febvre, Grand Rang.

BUILDING MATERIALS.

The province of Quebec possesses, in its different formations and in grea abundance, almost every kind of stone required for the purposes of both commo and decorative architecture; but, although carried on to some extent at variou points of the country, this industry may be said to be still in its infancy.

In the Laurentides, granites and gneiss of different colors are found, as we as white limestones which are sometimes serpentinous, and labradorites which ar well adapted for decoration.

In the southern section, blue, green and red slates, compact limestones, sand stone, &c., abound and are suitable for roofing, the making of quick lime, and fo use as marbles, paving, flagstones, &c. Certain sandstones also make excellen whetstones. In the same region, serpentines, magnesian limestones and fin grey granites are also plentiful.

In the valleys of the St. Lawrence and its tributaries, there are extensiv deposits of clay for common brick-making and beds of marl occur at differen points, while the existence of infusorial earth has been lately noted at St. Justin in the county of Maskinongé.

SLATES.

In the Eastern Townships, beds of schists are found, which belong to th Cambrian formation, and which are perfectly adapted for use as roofing slate These schists, which have been upraised without fracture, dip almost verticall in a general N. E. direction and seem to follow an anticlinal undulation, th principal of which embraces the quarries actually worked. At these quarries, se pentine is found, on one side, and sandstones or unconformable schists on the othe The existence of these slates has been long known, but they have as yet been onl partially wrought. Although the work is done by means of quarrying, it nevertheless expensive, because, in order to open a quarry, it is first necessar to discover a large rock surface and then to remove, frequently to a considerab depth, the rotten slates, before reaching the perfectly sound rock. There consequently a certain amount of risk to be run, which is all the greater, that

urn a profit, the works must be conducted on a large scale. Only a well-ened quarry, whose quality and quantity are well established, can be regarded possessing any value. This is the reason why there are so few quarries rked, although there is a pretty large demand for slates. Extensive works ve been undertaken and considerable sums of money have been expended at different points hereinafter specified.

The "New Rockland Slate Co." is at present taking out slate on a large le. In the adjoining township, the St. Francis quarry promises well. At nville, the object of the workings is to produce school slates. Slates are used different purposes, such as roofing, billiard tables, water tanks, school slates, The slates found in the province are of a grayish blue color; but red and en slates have been found in Acton, where they have been already worked to ne extent.

"ROCKLAND SLATE CO."

This slate quarry was opened in 1864, by the "Rockland Slate Co.", who rked it down to 1882.

At that date, the company reformed under the name of the "New Rockland te Co," and a greater impulse was given to the production.

The capital of the company was wholly applied to the purchase and stock-of the property. In 1886, a tramway with a guage of 30 inches and a length $1\frac{1}{8}$ miles was laid down to connect the quarry with the Grand Trunk Railway $\frac{1}{4}$ miles from Richmond, where the company has a siding, stores and wharves.

Except for pumping and drilling which are done by steam, the motive power erived from a water power on the Salmon River, where two turbines transmit necessary power, about 65 to 70 horse power, by means of cables 800 feet g, to the works.

The company's property embraces lots 21, 22, 23 of the IVth range of Mel-rne and the quarry is on lot 23, on a hill 140 feet over the surround-lands. The schists wrought for slates belong to the Cambrian formation dip almost vertically. Their color is a blueish grey. The band of workable e appears to be about 300 to 400 feet thick at this point and to be confined ween the unconformable schists and the serpentine. These schists appear to ur on an anticlinal running in a N. N. E. direction.

According to an analysis furnished by the company, the following would appear to be the composition of the slate :

Silica	65.39
Alumina	15.97
Ferrous oxide	4.66
Manganous oxide	0.39
Lime	0.67
Magnesia	2.99
Potash	3.60
Soda	3.33
Loss by ignition	3.26
	100.26
Specific gravity	2.75

This band is wrought by means of a quarry on two levels of 140 and 2 feet respectively, for a length of 500 feet and a width of 150 feet on top, with workable body of from 300 to 400 feet. The draining of the quarry is effecte by a 300 feet tunnel, which sends the water to the Salmon river.

The hoisting is done by means of five travelling derricks worked by the wat power. These derricks deserve special mention, as they effect the transport f a distance of 300 to 400 feet from a depth of 280 feet. They are worked wi the greatest ease and would be found advantageous in a host of other op workings.

Of the output of the quarry, it is estimated that only a small part goes to market in the form of slates, flagstones, water tanks, &c., the largest proportio being used as roofing slates in Canada. The special measure adopted for slates the "square." (1)

These slates are sold at $4 per square for first quality and $3 for second Flagstones or special objects are sold at prices ranging from 25 to 50 cents pe square foot of one inch thick.

The company has workshops run by water power, for cutting and polishin large flagstones, for cutting and splitting roofing slates, &c. It employs abou 200 hands, who are lodged in houses rented to them by the company. It als owns a saw-mill for lumber. The company ships about 45 car loads a month

(1) A "square" is the quantity of slates necessary to cover a square of 10 feet on all sides in roofing.

representing a total of about 6500 tons in 1889. Its slates are of a superior quality and compare favorably with the best English and American slates, tested specially for their breaking and crushing strain, they gave the best results.

The company's head office is at Montreal.

ST. FRANCIS SLATE QUARRY.

Long suspended, the working of this quarry was lately resumed by Mr. J. C. Bedard. On the occasion of my last visit, some 15 men were at work in an opening 300 feet long, 50 wide and 40 deep, and very fine-looking slate, like that of New Rockland, was being taken out. The quarry is on lot 5 of range XV, of the township of Cleveland at a quarter of a mile from the New Rockland Co's loading wharf.

Messrs. Abbott and Fryer were the first to undertake the opening of this quarry some years ago. The present owner proposes to work it on a large scale and its good location, as well as the quality of the rock, and the ease with which it is worked, promise excellent results. When first worked, only a few thousand squares were taken out, but it is now hoped to turn out from 3,000 to 5,000 a year. The quarry was formerly worked only by hand and with horse derricks, but it is now equipped with steam machinery for drilling, hoisting and pumping. M. J. C. Bédard is now also working with 25 men to open another quarry about 500 feet from the line of the Grand Trunk, and hopes to be able shortly to furnish employment to a staff of 50 men.

DANVILLE SLATE QUARRY.

The slate from this quarry is of very excellent quality and fine grain, which renders it suitable for school slates, water tanks, flagstones, &c., and generally for all the uses to which sawn and polished slate is applied. It is also adapted for roofing.

The quarry is on lot 7 of the IVth range of Shipton, (Richmond) 4 miles from Danville station, and employs some 60 men.

LIST OF LOTS ON WHICH SLATE HAS BEEN NOTED.

Bagot.....Acton, V, 25.
Beauce.....Jersey (River du Loup)
" .....Tring
Brome.....Sutton, II, 19.
Dorchester..Frampton, X, 2.
Drummond...Kingsey, I, 4.
Mégantic....Halifax, I, 14.
Richmond....Brompton, V, 29.
Cleveland, IX, 6. XV (5, 6, St. Francis Slate Quarry).
Melbourne, II, 22, 23; IV, (23 New Rockland Slate Quarry) V, 24, VI, 22, VII, 22.
Shipton, IV. (7 Danville Slate Co.) VII, 8.
Sherbrooke..Orford, V, 2.

LIMESTONES.

As wherever it outcrops, limestone is used either for quick-lime making or for building stone, it would be needless to describe all the quarries and kilns. We shall therefore limit ourselves to describing the different kinds of limestone met with in the province.

The Trenton limestone outcrops on the north shore of the St. Lawrence in the vicinity of Quebec as far as Ste Anne de la Pérade and then to the north of Three Rivers and in the neighborhood of Montreal.

At Lachevrotière, in the seigniory of Lachevrotière, and at St. Alban's, there are four extensive quarries, which supplied the stone used in constructing the Quebec public buildings, Parliament House, &c., and known under the name of Deschambault limestone. This stone, which is grey in color and easily cut, occurs in beds which furnish blocks of all sizes for building purposes and for railway bridging. It takes a fine polish and has been used in some instances for tombstones.

North of Three-Rivers, in the seigniory of Batiscan and Cap de la Madeleine, there are a number of kilns for quick-lime making from the Trenton limestone, which is also used as a flux in the iron blast furnaces of that district.

In the neighborhood of Montreal, there are numerous quarries, from which are taken the stone and lime required for the buildings and bridges of that city.

The pillars of the Victoria Bridge were in great part constructed of Trenton limestone. Several of these quarries are on the limestone of the Chazy formation, which also supplies fine building stones. There are quarries of this class at Hochelaga, Sault-au-Recollet, Terrebonne, &c.

The Trenton limestone again outcrops in the environs of St. Hyacinthe where it is used for making quick lime.

Below Quebec, it is found on the Côte de Beauport and at Château-Richer. The limestone from that place and from Château-Richer being used both for lime burning and for building-stone in the foundations of houses, &c. The darker limestone of Beauport can also be chipped with the hammer. Trenton limestone is also found at the river à la Rose, Baie St. Paul Murray Bay, the Mingan Islands, and lastly at Lake St. John. The Mingan stone, which is yellowish in color and very fine in the grain, takes a beautiful polish and can be used as lithographic stone. At all these points, the limestone is utilized either for building stone or lime-burning for local requirements.

The blackstone of Quebec is used to manufacture a cement known as the Gauvreau cement and is wrought by J. A. Gauvreau & Co.

According to an analysis made by M. Pfister, Professor at the Montreal Polytechnic School, the following is the composition of this limestone: (1)

Carbonate of lime	69.70
" " magnesia	1.12
Clay and free alumina	17.85
Sulphate of lime	1.61
Ferrous carbonate and pyrite	5.43
Hygrometric water	0.50
Organic matter, bitumen, alkalies, losses	3.79
	100.00

Eastern Townships' Limestones.—The principal centre of operations is in the townships of Dudswell, of which we shall have more to say hereafter. Limestone has been worked there for marble and lime-burning, as well as at St. Armand, South Stukely (Shefford) and at many other points.

The Eastern Townships are traversed by a band of magnesian limestone, which can occasionally be worked.

(1) Report of the Commissioner of Public Works of the province of Quebec for 1889.

In the Gaspé district, a limestone is found at Port Daniel, which yields a lime that enjoys a high reputation.

Laurentian Limestones.—The limestones of this formation are white and crystallized; but their grain is not fine enough to permit of their being classed among the better marbles; they nevertheless take a beautiful polish and may be used as common marble.

On lots A 10 of Pontefract and IV, 19, and adjoining lots of Litchfield (Pontiac), I met with an outcropping of limestone, the grain of which appeared remarkably fine; such limestone may, in our opinion, be found at other points of the Laurentian formation and be worked profitably for good marble. The limestone is sometimes mixed with serpentine and may furnish fine varieties, as in Grenville and Wentworth (Argenteuil).

Laurentian limestone occurs in Pontiac, Ottawa, Argenteuil, Joliette, Champlain and St. Maurice. It is sometimes used for lime-burning and yields a very fat lime. It has also been employed to some extent as ornamental stone at Ottawa, and the church of Notre-Dame du Désert, Maniwaki, is wholly built of white Laurentian limestone.

DOMINION LIME CO.

This company, which has its headquarters at Sherbrooke, also controls the "Dudswell & Sherbrooke Lime Co," both companies being under the same management. The "Dudswell & Sherbrooke Lime Co.," which has been established for 15 years runs, a quarry of compact blueish limestone on lot 18 of range VII of the township of Dudswell (Wolfe) and its works consists of a cutting, 500 feet long and 70 feet deep, in the flank of a hill. The surface of this quarry is on a level with the throats of the lime kilns, of which there are six in a single range, five of them being built of stone and one only of iron. All the work is done by hand.

The "Dominion Lime Co.," which was established two years ago, is operating three open quarries on small hills. Steam drills are employed. Small tramways connect these quarries with a battery of four kilns a short distance off. This company employs 40 men and the Dudswell Company 65. The capacity of each kiln is 300 bushels, turning out a carload per kiln or 10 carloads a day by the two companies. These kilns are close to wood which is used as fuel and which costs $1.50 per cord delivered at the kiln. Each kiln consumes 5 cords for each charge of 12 hours.

According to an analysis furnished by the company, the composition of the limestone is as follows :

Silica and insoluble	1.20
Lime	55.53
Carbonic acid	43.47
Oxide of iron	traces
Magnesia	traces
	100.00

This limestone belongs to the Upper Silurian system. The kilns run throughout the whole year and yield a fat lime of excellent quality, which is in part shipped to the United States, about 25 per cent. only of the output being consumed in Canada. This lime is considered to be specially suited to pulp making.

The extraction and carriage are done under very favorable conditions, the limestone only costing $0.20 per cubic yard, delivered at the kiln. The kilns are connected with the Quebec Central Railway by two branch lines. The Dudswell junction is 24 miles from Sherbrooke and 110 miles from Lévis. The company also owns a barrel mill.

According to the returns, supplied by the Geological Survey of Canada, the output has been as fellows :

1886	401,700	bushels worth	$75,700
1887	424,316	" "	79,137
1888	356,646	" "	61,489

These figures, however, are looked upon as very incomplete ; for instance those for 1886 were furnished by 16 producers, those for 1887, by 21, and those for 1888 by 7 only.

LITHOGRAPHIC STONE.

Beds of lithographic stone are found in the Trenton limestone. About 1880, an attempt was made in the neighborhood of Château-Richer to work a grey stone with a very fine grain, which was believed to be adapted to lithography.

The very light colored Mingan stone (North shore) seems to us to be equally adapted to the same use and occurs, it is said, in workable beds.

SANDSTONES.

A sandstone suitable for building purposes is found in the Potsdam formation and has been noted at Lachute, Beauharnois, &c., and at the Grès on the St. Maurice. At the latter point, it has beeen used for the masonry of the blast furnaces. The Chazy formation also yields a sandstone, which has been used in the works of the Grenville Canal.

At St. David de l'Aube Rivière, county of Lévis, a greenish sandstone has been worked and employed in the sub-basement of the Parliament Buildings and the Quebec Court House. This sandstone belongs to the Sillery formation. In the neighborhood of St. David and at St. Joseph de Lévis another greyish sandstone has been worked and used for paving Mountain Hill, Québec, and in the construction of the forts at Lévis.

At Trois Pistoles, a red and white sandstone is found which has been used on the works of the Intercolonial railway and for house-building in Quebec.

At Cap à l'Aigle, near Murray Bay, (Charlevoix county) a green and white sandstone has been worked and used for the front of the Quebec Court House.

In the environs of Gaspé Basin, there is a fine gray sandstone belonging to the Gaspé series, which is well adapted to use.

GRANITE.

We have already referred to the granites of the Laurentian system and the Eastern Townships. They have been put to local uses in a certain number of places and it is unquestionable that the Laurentian formation can furnish very beautiful granites. These Laurentian granites have been worked in the township of Grenville (Argenteuil). On the line of the Lake St. John Railway, near the Miquick river (county of Portneuf), a greyish variety has been found and used to construct the base of the Jacques-Cartier monument and the enclosure wall of the Quebec Court House. This quarry is owned by Mr. Belanger, a Quebec marble-cutter, who is now working it. Other granites have been noted along the same line of railway. The church of Hebertville, Lake St. John, is built of the red country granite. The Geology of Canada, 1863, mentions a number of localities, where the gneiss, granites and syenites are adapted to building purposes. We ourselves seen handsome red granite near St. Jean de Matha (Joliette), at Point (North Shore) and specimens have also reached us from the Mis- in the Lake St. John region. In addition to the Laurentian granites,

we have also referred to the greyish granites found at several points of the Eastern Townships in the counties of Compton and Stanstead. At the London Colonial Exhibition of 1886, a number of specimens of workable granite were shown by the Geological Survey of Canada.

To our knowledge there is but one quarry worked in Stanstead. We append some information in regard to this undertaking:

STANSTEAD GRANITE.

Messrs. Haselton & Moir run two granite quarries on lots 3 of the IVth range and 2 of the IIIrd range of Stanstead. The first, which is the most important, was opened in 1888 and has been in constant operation since that time.

According to the owners, the annual output shipped from 1875 to 1885 was 50 carloads. Since then the quantity has increased until in late years when it reached:

In 1888,	125	carloads	equivalent	to	20,000	cubic	feet
In 1889,	175	"	"	"	24,000	"	"

A carload amounting to 130 to 140 cubic feet.

The price of the granite varies according to the size of the blocks, but, in a general way, the figures are as follows:

Per cubic	foot	$0.50	for blocks of		25 to	35	square feet
"	"	0.75	"	"	50	"	
"	"	1.00	"	"	60	"	
"	"	1.25	"	"	75	"	

Smaller sized blocks are worth 35 cents per cubic foot and for a thickness of less than 8 inches, 25 cents per linear foot.

The two quarries employ 25 to 35 men during the summer. In winter the number is smaller and only for dressing the granite.

The quarry on lot 3 on the IV range is 1½ mile from the station at Stanstead junction (Boston and Maine R.R. Passumpsic), from which the stone is shipped. The quarry on III 2 is on the shores of Lake Memphremagog, and the output is shipped by the lake. The granite is of fine quality, greyish white in color, fairly close in grain, easily cut and very strong in resisting power.

At the points where it is wrought, it outcrops in the shape of small hills or ounds and the workings are not deep, all the operations being performed by hand.

This granite is largely used for building and railway purposes in the region. t Sherbrooke, the buildings of the Eastern Townships Bank and the Post Office ave been constructed of it, while it is also freely employed for works of art. A ood deal is also shipped to Montreal and it has further been used at Quebec for ie enclosure wall of the grounds of the Parliament Buildings.

CLAYS.

The clays form a heavy band in the St. Lawrence valley between Quebec nd Montreal, as well as at many other points of the country. They are generally f the ordinary or common character suitable for brick, pottery and delft-making. t is not to our knowledge that refractory clays or kaolin have been found in the rovince of Quebec.

According to the statistics of the Geological Survey, the output of bricks would appear to be as follows:

1886.....	23 reports	14,175	thousands	worth	$ 83,025
1887.....	25 "	18,820	"	"	80,117
1888.....	22 "	24,925	"	"	167,591

These figures are regarded as far below the real production, owing to the incomplete number of the reports.

There are large brickyards at St. Jean Deschaillons. on the river St. Charles, near Quebec, at St. Thomas de Montmagny, at Ascot, near Sherbrooke, at St. Gabriel de Brandon, at River du Loup, etc., etc., and a multitude of other places.

RARE OR PRECIOUS MINERALS.

Although no mining for precious stones is carried on in the province Quebec, a great variety of gems is nevertheless found especially in the Laure tian rocks, (2) which in some instances are adapted to the purposes of jeweller

Brown and red garnets are met with at very many points in the Laure tides and the gneiss is often so filled with them as to become a nearly pu garnet rock. At St. Irenée (Charlevoix), crystals, five or six inches in diamete have been found. The mica mines also contain fine specimens of them, and the presence has also been noted in the shore sands of the Gulf of St. Lawrence.

Ouwarovite or green chrome garnet has been found on lot XII, 6, of Orfo (Sherbrooke) associated with nickel ore. These garnets are very handson in color, but unfortunately too small to be utilizable. It is said however th larger ones have been found in Wakefield (Ottawa).

The common emerald or beryl occurs in all the mica mines and sometimes pretty large crystals, but none have yet been found of value for jewellery. In t same mines, black or green tourmalines are abundant and some rose-colore specimens of these stones have also been met with.

Spinel has been found in the seigniory of D'Aillebout (Joliette), and Wakefield; zircon in Templeton and Grenville; epidote, associated with gnei on the North Shore of the St. Lawrence, and among the Shick-Shock mountai in the Gaspé district; olivine, in the eruptive rocks of the Eastern Townshi and in Mount Royal; green or blue fluorite at several points in the Laurentia rocks and notably at Hull, Baie St. Paul, &c. Certain varieties of opalescent colored feldspar occur in the Laurentides; the feldspars commonly called moo stone (adularia) and amazon-stone (microline), are met with on the North Sho of the St. Lawrence and also in some mica mines. Amazon stone has also bee noted in Hull and Wakefield. Opalescent labradorite exists in great quantiti on the North Shore of the Gulf St. Lawrence, especially from Thunder river Sheldrake, and might be utilized for decorative purposes and the choi

(1) Geological Survey, Canada, 1887-88.
(2) Geological Survey, Canada, 1877-78.

crystals for the purposes of jewellery. Some very beautiful specimens are common in all the mineralogical collections of the country.

The varieties of quartz, such as agate, jasper and rock crystal, are met with at several points in the province; agate pebbles at Cape Rosier in the Gaspé district; jasper on the North Shore, at Hull, and in some parts of the Eastern Townships, and real rock crystal in considerable abundance in the Villeneuve mica mine. This Villeneuve mine, which has been mentioned often in the course of this work, holds in addition some very rare and curious minerals such as monazite, cerite, uraninite, etc., which have been already alluded to. At the Maisonneuve mica mine in Joliette, specimens of samarskite have been found. These minerals however are encountered in very small quantities.

The titanic iron deposits contain the usual ores of titanium, ilmenite, rutile, brookite, etc. In the copper mines, some specimens of malachite are occasionally found, but too small to of be gem value. A variety of compact diversely colored steatite occurs at some points of the Eastern Townships in association with the serpentines of that region.

Other cabinet minerals are found in the province and may be be seen in all the geological museums, but thus far, together with those above noted, they possess hardly any but a scientific importance.

MINING LAWS.

Our mines are regulated by "The Quebec General Mining Act, 1880" (43-44 Victoria, chapter 12), and the subsequent acts amending the same (44-45 Vict., chap. 9; 47 Vict., chap. 22; 49-50 Vict., chap. 30 and 51-52 Vict., chap. 15), the whole embraced in the Revised Statutes as amended by 52 Vict.

The mining rights belong to the Crown:

1o In the case of *gold* and *silver;* throughout the province, except on lands whereon such rights have been regularly conceded. (1426 R. S.)

2o. In the case of *phosphates*: on all lands not patented for agricultural purposes before the 9th March, 1878. (1428 R. S.)

3o. In the case of *other* minerals: on all lands sold for agricultural purposes and not patented before the 24th July, 1880. (1429 R. S.)

4o. On all lands actually belonging to the Crown, (1423 R. S.)

5o. On all other lands, whatever may be the date of their letters patent, when such letters patent contain a clause specially reserving the minerals. (1425 R. S.)

Private individuals may acquire these mining rights on the following terms:

(See 1442 R. S. and Order in Council, 10th December, 1885.)

1o. For iron and ochre, at $2.00 per acre.

2o. For phosphate, gold, silver, asbestos, lead, mica, plumbago, copper and generally all minerals except iron and ochre, at $5 per acre.

These figures cover the price both of the surface and of the mining rights. In the case where the surface has been purchased for agricultural purposes, it is only necessary to pay the balance of the $2 or the $5 per acre due for the property under the soil.

As regards the gold and silver in the gold mining divisions of the Chaudiere and St Francis, the lands are granted according to the "claim" system and may be acquired by purchase, lease, or by license and occupation permit on complying with the requirements of the law.

Gold and silver are subject to a royalty of $2\frac{1}{2}$ per cent. on the gross amount of the gold or silver obtained and $0.50 cts. for and on each ton of phosphate of lime in its raw state also collected. (1435 R. S.)

The proprietor of the soil has a preferential right over all other persons to the purchase of the mine discovered on his land on complying with the requirements of the law. (1433 and 1440 R. S.)

The Lieutenant-Governor in Council may modify the prices and conditions of sale, lease, &c. (1442 R. S.)

The mining rights may form a property separate from the soil. (1424 R. S.)

SUNDRY.

We have noted as far as possible all the economic minerals found in the province; still there are a few others which may be regarded as accidental:

Alum.—On lot 1 of the Vth range of Ireland (Megantic) slate schists, impregnated with alum, are met with. This product, however, does not appear to have had a mineral origin. It seems rather to have been derived from chemical combinations on the surface between the ashes of burnt wood and the iron pyrite in the schists.

Sulphate of Baryte occurs in unimportant veins in the Laurentian rocks, especially in the county of Ottawa and in the neighborhood of the Saguenay.

CUSTOMS' DUTIES

For the public information, we append an extract from the Canadian, as well as from the American tariffs, showing the duties on minerals or the products connected therewith.

N. S. E. means "not specified elsewhere."

N. E. S. MEANS *NOT ELSEWHERE SPECIFIED.*

CANADA CUSTOMS' TARIFF

(REVISED TO 25TH JUNE, 1890.)

Metals, Ores, Mineral and Chemical Products on which duties are charged.

Acid sulphuric	½ct per lb.	
Alum, N. E. S	20 per cent	*ad valorem*
Antimony, N. E. S	20 per cent	"
Antimony, regulus	20 per cent	"
Asbestos, crude	20 per cent	"
Asbestos, in any other form than crude, and all other manufactures thereof	25 per cent	"
Asbestos, pulp	20 per cent	"
Acid, phosphate	3 cts. per lb	
Barytes	20 per cent	"
Brick, building	20 per cent	"
Bricks and tiles, hollow and porous, firebrick N. E. S	20 per cent	"
Brick for lining stoves	30 per cent	"
Babbit, metal	10 per cent	"
Cement, stone or water limestone, from the quarry, per ton of 13 cubic ft.	$1.00	
Cement, hydraulic or water lime, ground, Portland and Roman, including barrels	40cts per barrel	
Cement in bulk or in bags	9cts per bushel	
Cement, Portland or Roman, in bulk or in bags	9cts per bushel	
Cement, other	N. E. S. 20 per cent.	"
Chalk, manufactured	20 per cent.	"
Coke	50cts per ton of 2000 lbs.	
Copper in sheets of less than 4 inches wide	15 per cent.	"
Copper, old and scrap, in pigs, bars, rods, bolts, etc., seamless, drawn, tubing, copper sheathing not polished or coated	10 per cent.	"

Coal tar and pitch.....10 per cent. *ad valorem*
Coal, bituminous, per ton of 2000 lbs.....60cts.
Coal, dust, other N, E. S..... .20 per cent. "
Coal oil and kerosene distilled, purified N.E.S. 7 1/5 per Imp. gal.
Carbolic or heavy oil .....10 per cent, "
Diamonds, set.....20 per cent. "
Fuller's earth.....30 per cent. "
Fireclay, retorts, crucibles, gas retorts, gas logs.....,20 per cent. "
Ferro-manganese, ferro-silicon.....$2.00 per ton
Cast iron vessels, etc .....$16 per ton, but not less than.....30 per cent. "
Iron bars, railway bars or rails of iron or steel for railways or tramways of any form, pinched or not pinched N. E. S.....$6.00 per ton.
Sheet iron, common or black, not thinner than No. 20 gauge.....$13.00 per ton.
(1) Pig iron .....$4 per ton.
Lead, old, scrap and pig .....40cts per 100 lbs.
Lead bars, blocks and sheets.....60 cts per 100 lbs.
Lead, all manufactures of, N. E. S.....30 per cent. "
Mineral waters, N. E. S.....20 per cent. "
Marble blocks and slabs, sawn on more than two sides .....25 per cent. "
Marble blocks, from the quarry, in the rough, or sawn on two sides only, and not specially shaped, containing 15 cubic feet and over.....15 per cent. "
Marble in blocks from the quarry wrought or sawn on two sides only, and not especially shaped, containing less than 15 cubic feet..... .10 per cent. "
Marble, finished, and all manufactures of, N. E. S.....35 per cent. "
Metal composition, N. E. S.....20 per cent. "
Mica.. ..... 20 per cent. "
Mineral pulp.....20 per cent. "
Nickel and German silver, manufactures of, not plated .....25 per cent. "
Nickel and German silver, manufactures of, if plated.....30 per cent. "
Nickel salts..... 20 per cent. "
Oxides, ochres, ochrous earth, fireproof, umbers and siennas, ground and unground, washed or unwashed, calcined or raw..... .....30 per cent. "
Plaster of Paris or gypsum, ground, not calcined.....10 cts per 100 lbs.
Plaster of Paris, calcined or manufactured....15 cts per 100 lbs.
Plumbago..... ..15 per cent. "
Plumbago, manufactures of.....30 per cent. "
Platinum, N. E. S.....20 per cent. "
Pencils, Lead, in wood or otherwise.....30 per cent. "
Pencils. Slate..... ....25 per cent. "
Slates, for roofing, black and blue, when split or dressed only .....80 cts per square.

(1) The Ottawa Government, in order to encourage the manufacture of iron, grants a bounty of $1.00 per ton upon iron pig made in Canada out of Canadian ore.
This bounty will be of $2.00 per ton, from the 1st July 1892 to June 30, 1897.

Slates, for roofing, red, green or other colors, when split or dressed only.....$1 per square.
Slates, school and writing slates.....1 ct each and.....20 per cent *ad valorem*
Slates of all kinds and manufactures of, N.E.S.1 ct per square foot and.....25 per cent "
Slate mantles.....30 per cent "
Slate slabs, square and in special shapes.....1 ct per square foot and.....25 per cent "
Steel, sheets of all gauge and widths, N. E. S. valued at 4cts or less per lb, but not less than$12 per ton.....30 per cent "
Steel springs and axles of all kinds for cars and tramways.....$30 per ton but not les than.....35 per cent "
Stone, flagstones, sawn or otherwise dressed..$2.00 per ton.
Stone, grindstones, not mounted and not less than 12 in. in diameter.....$2.00 per ton.
Stone, rough freestone, sandstone and all building stone except marble from the quarry, not hammered or chiselled (13 cubic feet to ton).....$1 per ton.
Stone, dressed freestone and all other building stone except marble, and all other manufactures of stone or granite N. E. S.....30 per cent "
Stone, Lithographic not engraved.....20 per cent "
Stones precious, N. E. S. polished, but not set or otherwise manufactured and imitation thereof.....10 per cent "
Stones precious, other N. E. S.....20 per cent "
Sand, colored.....20 per cent "
Superphosphates, or manufactured fertilizers.....20 per cent "
Tinware and all other manufactures of tin N. E. S.....25 per cent "
Zinc, manufactures of, N. E. S.....25 per cent "

Metals, Ores, &c., exempt from duty in Canada.

Alum, in bulk only, ground or unground.
Aluminum and alumina, sulphate and chloride of alumina.
Antimony, not ground, pulverized or otherwise manufactured.
Arsenic.
Bismuth, metallic, in its natural state.
Borax, ground or unground in bulk of not less than 25 lbs only.
Brass, old and scrap.
Boracic acid.
Bricks for bakers' ovens, for building or repairing furnaces, for gas works, bath-bricks.
Burr stones, in blocks, rough or unmanufactured, not bound up or prepared for binding into mill stones.
Bullion, gold and silver in bars, blocks or ingots.
Clays, fire clay, pipe clay.
Cinabar.
Colors, metallic, viz. oxide of cobalt, zinc and tin, N. E. S.
Cobalts, ore of.
Chalk and cliff stone, ground or unground.
Copper and brass, in sheets or plates of not less than 4 inches in width.
Coal, anthracite.
Coal dust. (Anthracite coal dust.)
Coal for steamers on outward voyage to British or foreign ports. (Ship's stores).
Diamonds, unset, including black diamonds for borers.
Diamond drills, for prospecting for minerals, not to include motive power.
Diamonds, dust or bort.
Emery, in blocks crushed or pounded.
Feldspar.
Fuller's earth, not prepared.
Gypsum, crude, (sulphate of lime).
Gravels and sand.
Gas coke (the product of gas works) when used in Canadian manufactures only.
Scrap iron, and scrap steel, and fit only to be manufactured, being part of recovered from any vessel wrecked in waters subject to the jurisdiction of Canada.
Iron Angles, Anchors, Beams, Knees, Masts, Plates (iron or steel combined) sheet iron, for iron of composite ships or vessels.
Kryolite.
Litharge.
Mineralogical specimens.
Mineral waters, natural, not in bottles.
Manganese, oxide of.
Machinery, mining machinery imported within three years after the passing of this act, which is at the time of its importation of a class or kind not manufactured in Canada.
Mercury, or quicksilver.
Metal, yellow metal, in bars, bolts and for sheathing.
Nickel.
Ores of metal, of all kinds, gold, silver, cobalt, &c.

Precious stones, in the rough, viz. Agate, Amethyst, Aqua Marine, Blood Stone, Carbuncle, Cats' eyes, Cameo, Coral, Cornelian, Crystal, Crysolite, Crosordolite, Emerald, Garnet, Intaglio, Inlaid or Encrusted Stones Onyx, Opal, Pearl, Ruby, Sardonyx, Sapphire, Topaz and Turquoise.

Precipitate of copper, crude.

Pumice, and pumice stones ground or unground.

Platinum wire.

Platinum tubing, pipes, &c., to be used in manufacture of sulphuric acid. (See Retorts.)

Retorts, condensers, tubing and pipe made of platinum imported by manufacturers of sulphuric acid, for use in their manufacture of concentration of sulphuric acid.

Silex or crystallized quartz.

Sulphate of iron, (copperas.)

Sulphate of copper.

Sulphur in rolls or flour.

Steel sheets for iron or composite ships.

Steel sheets of not less than 11 or not over 18 wire gauge and costing not less than $75 per ton of 2,240 lbs., when imported by manufacturers of shovels and spades for use exclusively in such manufactures in their own factories.

Steel sheets, crucible sheets, 11 to 16 gauge, 2½ to 18 inches wide, imported by manufacturers of mower and reaper knives for manufacture of such knives in their own factories.

Terra Japonica.

Tin in blocks, pigs, bars and sheets.

Tin plates.

Zinc in blocks, pigs and sheets.

Zinc, metallic color.

Zinc, dust.

AMERICAN TARIFF. (1)

(REVISED TO 6TH OCTOBER, 1890)

Metals, Ores, Mineral and Chemical Products on which duties are charged.

Acid, sulphuric or oil of vitriol..... .....¼ct
Alumina, alum, alum cake, patent alum, sulphate of alumina and aluminous cake, and alum in crystals or ground..... .....6/10ct.
Blue vitriol or sulphate of copper.....2cts
Borax, crude or borate of soda or borate of lime.3ct
Refined Borax..... .....5ct
Copperas or sulphate of iron .....3/10ct.
Iodine, resublimed..... .....30cts
Baryta, sulphate of barytes, unmanufactured per ton:.....$1.12
Manufactured per ton.....$6.72
Chrome, yellow, green, and all other chromium colors in which lead and bichromate of potash or soda are component parts. 4½ct
Ochre and ochrey earths, sienna, umber, dry...¼ct
Vermillion, red and colors containing quicksilver.....12cts
Zinc, oxide, dry.....1¼ct
Litharge 3cts
Firebrick, plain, per ton $1.25
Glazed, enameled or decorated.....45 per cent.
Tiles and brick, plain.....25 per cent.
Ornamented.....45 per cent.
Cement, Roman, Portland, hydraulic, in packages, including weight of packages of 100 lbs.8cts
In bulk.....7cts
Other cement .....20 per cent.
Lime per 100 lbs. including weight of package.6cts

(1) When a special unit of quantity like ton, bushel, gallon etc., is not specified, the figures mean the duties per pound.

Plaster of Paris or gypsum, ground per ton....$1.00
Calcined, per ton.....$1.75
Clays or earths, unmanufactured, per ton.....$1.50
Wrought or manufactured per ton.....$3.00
China clay or kaolin, per ton.....$3.00
Marble, rough or squared, per cubic foot.....65cts
Veined marble, sawed or dressed, per cubic foot.$1.10
Other manufactures of .....50 per cent.
Burr stones.....15 per cent.
Freestone, granite,sandstone, limestone, building stone, unmanufactured, per cubic foot...11cts
Hewn, dressed or polished.....40 per cent.
Grindstones, per ton.....$1.75.
Slate, mantels, slabs.....30 per cent.
Roofing slate.....25 per cent.
Iron ore, per ton.....75 cts.
Iron sulphur ore containing not more than 3½ per cent of copper, per ton.....75cts.
More than 2 p.c. of copper,in addition on the copper.....½ ct.
Iron in pigs, kontledge, scraps.....3/10ct.
Bar iron 1 in. wide ⅜ in. thick.....8/10ct.
Bound iron ¾ in. diameter.....9/10ct.
Iron bars, blooms, billets made by charcoal fuel, per ton.....$22.
Forgings of iron or steel.....2 3/10cts.
Railway bars of iron or steel.....6/10ct.
Castings of malleable iron.....1¾ ct.
Aluminum, crude and alloys.....15 per cent.
Antimony, regulus or metal.....¾ ct.
Brass bars, pigs, old brass, yellow metal fit only for manufacture.....1½ ct.
Copper ores.....1½ ct.
Old copper for manufacture.....1 ct.
Regulus of copper and copper cement.....3½ ct.
Copper in plates, bars or ingots not manufactured.....1¼ ct.
Gold leaf, per pack 500 leaves.....$2.
Silver leaf, per pack 500 leaves.....75 cts.
Lead ore and lead dross.....1½ ct.
Provided that silver ore and all other ores containing lead shall pay a duty of ½ ct. per pound on lead therein.
In pigs and bars, molten and refuse.....2 ct.
In sheets, pipes, shot.....3 ct.
Metallic mineral substances, metals unwrought, not specially provided for.....20 per cent.
Nickel, nickel oxide alloy.....10 ct.
Quicksilver.....10 ct.
Tin, black oxide, bar, block and pig, on and after January 1, 1893.....4cts.
Zinc, in blocks or pigs.....1¾ ct.
In sheet.....2½ ct.
Old for manufacture.....1¼ ct.

Manufactures of alabaster, amber, asbestos, bladders, coral, gut, jet paste, spar and wax.....25 per cent.
Lead pencils, per gross.....50ct and 30ct.
Slate pencils, per gross.....4ct.
Pencil leads, not in wood.....10 per cent.
Coal, bituminous and shale per ton.....75cts.
Coal, slack or culm per ton.....30cts.
Coke.....20 per cent.
Precious stones cut but not set.....10 per cent.

Metals, ores, etc., exempt from duty in U. S.

Antimony ore, crude, sulphide of.
Apatite.
Arsenic and sulphide of, or orpiment.
Asbestos, unmanufactured.
Baryta, carbonate of witherite.
Bauxite, or bauxite.
Bismuth.
Bromine.
Cadmium.
Calamine,
Cerium.
Chalk, unmanufactured.
Charcoal.
Clay—Common blue clay in casks suitable only for crucibles
Coal stores of American vessels, but none shall be unloaded.
Coal tar, crude.
Cobalt, and cobalt ore.
Copper, old taken from the bottom of American vessels in foreign ports.
Cryolite.
Diamonds and other precious stones, rough or uncut, diamond dust and jewels to be used in watches.
Emery ore.
Feldspar.
Flint, flints and ground flint stones.
Guano, manures and all substances expressly used for munures.
Hones and whetstones.
Iodine, crude.
Iridium.
Kieserite.
Kyanite, or cyanite and kainite
Lava, unmanufactured.
Lithographic stones not engraved.
Loadstones.
Magnesite.
Magnesium.
Magnets.
Manganese, oxide and ore of.
Mineral waters, all not artificial.
Minerals, crude, or not advanced by manufacture.
Ores, of gold, silver and nickel and nickel matte. Provided that ores of nickel and nickel matte, containing more than 2 p. c. of copper, shall pay a duty of one half of one cent per pound on the copper contained therein.
Osmium.
Palladium.
Pewter and Britannia metal, fit only to be manufactured,
Phosphates, crude or native,

Plaster of Paris, and sulphate of lime, unground.
Platina, in ingots, bars, sheets and wire.
Platinum, unmanufactured, and apparatus of platinum for chemical uses.
Plumbago.
Polishing stones.
Pumice.
Sodium.
Specimens of mineralogy for cabinets or as objects of science.
Stone and sand burrstone in blocks, rough or manufactured pumice stone, rotten stone and sand, crude or manufactured.
Strontia, oxide, protoxide, strontianite.
Sulphur, lac or precipitated, and sulphur or brimstones crude, in bulk (75 cents per ton), sulphur ore as pyrites or sulphurite of iron in its natural state, containing in excess of twenty five per cent of sulphur (except on the copper contained therein) and sulphur not otherwise provided for.
Sulphuric acid which at the temperature of sixty degrees Fahrenheit does not exceed the specific gravity of one and three hundred and eighty thousandths for use in manufacturing superphosphate of lime or artificial manures of any kind, or for any agricultural purpose.
Tin ore and tin in bars, blocks, pigs or grain or granulated, until January 1, 1892,
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